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Interim Record of Decision for Operable Unit 1 at the Barite Hill / Nevada Goldfields Superfund Site McCormick, South Carolina

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GEORGIA

CERCLIS ID: SCN000407714

September 2020

PART 1: DECLARATION

1.0 Site Name and Location

This Interim Record of Decision (IROD) is for Operable Unit 1 (OU1) at the Barite Hill/Nevada Goldfields (Barite Hill) Superfund Site (Site) located in McCormick County, South Carolina (SC). The Site's Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number is: SCN000407714. The Site was listed on the National Priorities List (NPL) April 9, 2009. The Site is located approximately three miles southwest of the town of McCormick in McCormick County, South Carolina. The 795-acre site is located west of U.S. Route 221 and north of State Road S-33-30 (**Figure 1**). Coordinates for the Site are 33°52'25" N, 82°17'41" W (U.S. Environmental Protection Agency [EPA], 2012). Approximately 135 acres of the property have been disturbed by historic and modern mining, with the remainder of the property serving as an undisturbed buffer zone (**Figure 2**). Gold and silver mining operations occurred between 1991 and 1995. The Site is surrounded by forested and agricultural land and rural residential areas. No buildings, homes or commercial facilities are located within a 0.25-mile radius of the Site.

2.0 Statement of Basis and Purpose

This decision document presents the Interim Remedy for OU1 at the Site, which was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) 42 U.S.C. Section 9617 of the Superfund and the National Oil and Hazardous Substances Pollution Contingency Plan ([NCP], 1994) as set forth in 40 Code of Federal Regulations (CFR) Part 300.430(f)(2). This decision is based on the Administrative Record (AR) for the Site.

The State of South Carolina, as represented by the South Carolina Department of Health and Environmental Control (SCDHEC), is the support agency. In accordance with 40 CFR Sec 300.430(f)(2), SCDHEC has provided input during the remedial investigation/feasibility study (RI/FS) and decision-making process.

The State of South Carolina concurs with the Interim Remedy.

3.0 Assessment of the Site

The response action selected in this IROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances; and pollutants or contaminants from this Site which may present an imminent and substantial endangerment to public health or welfare. Acid mine drainage is resulting in metals contamination of groundwater, surface water, sediment and soil.

4.0 Description of the Interim Remedy

OU1 has been divided into three contaminated media zones (CMZs) in order to aid in the screening, evaluation and selection of the interim Remedial Action (RA): Pit Lake (CMZ-1); Capped Waste Rock (CMZ-2); and OU1 Groundwater (CMZ-3).

The NCP establishes an expectation that the EPA will use treatment methods to address the principal threats posed by a site whenever possible (NCP §300.430(a)(1)(iii)(A)). Principal threat wastes (PTW) are highly toxic or highly mobile materials that may present a significant risk to human health or the environment if exposure were to occur. They include liquids and other materials having high concentrations of toxic compounds (for example, metals). The NCP establishes an expectation that the EPA will: (1) use treatment to address the principal threats posed by a site wherever practicable – NCP Section 300.430(a)(1)(iii)(A); (2) use engineering controls for waste(s) that pose a relatively low long-term threat or where treatment is impracticable; (3) use institutional controls (ICs); or (4) use a combination of methods to achieve protection of human health and the environment.

The capped waste rock at Barite Hill OU1 is considered to be a principal threat waste at this Site. Groundwater and surface water impacts indicate that contaminants leaching from the waste rock are present and highly mobile.

The selected Interim Remedy will be completed in phases and includes the following components:

Phase I

- Install a barrier wall and/or grout curtain to divert unimpacted OU1 Groundwater (CMZ-3) from oxidizing the Capped Waste Rock (CMZ-2)

Phase II

- Amend the Capped Waste Rock (CMZ-2) with reactants (e.g., sodium lauryl sulfate and milk) to neutralize and prevent acid generation
- Expand and/or enhance the existing cap over the waste rock and potentially dewater the Capped Waste Rock (CMZ-2) area by pumping contaminated groundwater into the Pit Lake

Phase III

- Amend the Pit Lake (CMZ-1) with alkalinity and organic carbon to increase the pH and reduce metals concentrations
- Cover the Pit Lake floor with an impermeable cap to seal off and prevent groundwater from discharging into and from the Pit Lake through fractures and seeps to the North Tributary
- Install open limestone channels where stormwater discharges into the Pit Lake and at the Pit Lake spillway
- Monitor water quality in the Pit Lake and the North Tributary

5.0 Statutory Determinations

This interim action is protective of human health and the environment in the short term and is intended to provide adequate protection until a final ROD is signed; complies with (or waives) those federal or more stringent state environmental requirements that are applicable or relevant and appropriate (ARARs) for this limited-scope action; and is cost-effective. Although this interim action is not intended to address fully the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action does utilize treatment with addition of amendments to the Capped Waste Rock and the Pit Lake and thus supports the statutory mandate. Because this action does not constitute the final remedy for OU1 at the Site, the statutory preference for remedies that employ treatment that reduces toxicity, mobility or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action.

Because this remedy will result in hazardous substances remaining on-site above levels suitable for unrestricted use and unlimited exposure, a statutory five-year review pursuant to CERCLA Section 121(c) will be conducted to ensure that the remedy continues to provide adequate protection to human health and the environment within five years after commencement of the interim action. Because this is an interim action ROD, review of this Site and remedy will be ongoing as EPA continues to develop remedial alternatives for all OUs at the Site.

6.0 ROD Data Certification Checklist

The following information is included in the Decision Summary Section of this ROD. Additional information can be found in the AR file for this Site.

- Baseline risk represented by the chemicals of concern (COCs) (Section 7; **Tables 1 through 12**)
- COCs and their respective concentrations (Section 7)
- COCs and their respective cleanup levels (Section 8; **Table 13**)
- How source materials constituting principal threats are addressed (Section 11)
- Current and reasonably anticipated future land use assumptions (Section 6)
- Potential land use that will be available at the Site as a result of the Interim Remedy (Section 6)
- Estimated capital, annual operation and maintenance (O&M), and total alternative costs, and the number of years over which the remedy cost estimates are projected (Section 12; **Table 17**)
- Key factors that led to selecting the remedy (i.e., how the Interim Remedy provides the best balance of tradeoffs with respect to the balancing criteria, highlighting criteria key to the decision) (Section 10)

7.0 Authorizing Signature

CAROL MONELL Digitally signed by CAROL MONELL
Date: 2020.09.30 12:17:45 -04'00'

Carol J. Monell, Director — Date
Superfund & Emergency Management Division

INTERIM RECORD OF DECISION

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ACRONYMS AND ABBREVIATIONS

%	percent
amsl	above mean sea level
AR	Administrative Record
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency of Toxic Substances and Disease Registry
bls	below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CMZ	Contaminated Media Zone
COC	chemical(s) of concern
COPC	chemical(s) of potential concern
CSF	cancer slope factor
CSM	conceptual site model
cy	cubic yard
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
EPC	exposure point concentration
ESD	explanation of significant difference
FS	Feasibility Study
ft	foot or feet
FYR	Five-Year Review
HH&E	human health and environment
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
HRS	hazard ranking score
IC	institutional control(s)
MCL	Maximum Contaminant Level
Mgal	million gallons
mg/kg	milligram per kilogram
mg/kg/day	milligram per kilogram per day
mg/L	milligram per liter
mg/m^3	milligram per cubic meter
µg/kg	micrograms per kilogram
NCP	National Oil and Hazardous Substance Pollution ContingencyPlan
NPL	National Priorities List
O&M	operation and maintenance
OLC	Open limestone Channel
ORP	oxidation reduction potential

OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OTIE	Oneida Total Integrated Enterprises
OU	Operable Unit
pH	hydrogen ion concentration
PTW	Principal Threat Waste
lbs	pounds
RAC	Remedial Action Contract
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RGs	remedial goals
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SESD	EPA Science and Ecosystems Support Division
SC	South Carolina
SCDHEC	South Carolina Department of Environmental Control
Site	Barite Hill/Nevada Goldfields OU1 Superfund Site
START	Superfund Technical Assessment and Response Team
SVOC	semi-volatile organic compound(s)
TBC	to be considered
TDS	total dissolved solids
TEQ	toxicity equivalent
Tetra Tech	Tetra Tech, Inc.
T/M/V	toxicity/mobility/volume
TOC	total organic carbon
USGS	United States Geological Survey
VOC	volatile organic compound
XRD	X-ray diffraction

PART 2: THE DECISION SUMMARY

1.0 SITE NAME AND LOCATION

This Interim Record of Decision (IROD) is for OU1 at the Barite Hill/Nevada Goldfields Superfund Site (Site) (EPA CERCLIS ID: SCN000407714) in McCormick County, South Carolina and covers 795 acres west of U.S. Route 221 and north of State Road S- 33-30 (**Figure 1**).

Approximately 135 acres of the property has been disturbed by historic and modern mining. The remaining property serves as an undisturbed buffer zone (**Figure 2**). Gold and silver mining operations occurred between 1991 and 1995.

The Site is unoccupied and not currently in use. The former mining area is bordered by a discontinuous barbed wire fence with a locked chain link gate present at the main road entrance to the Site. The surrounding area is rural, undeveloped and sparsely populated. No buildings, homes or commercial facilities are located within 0.25 mile of OU1.

Signs of recreational all-terrain vehicle (ATV) use have been observed in the past on lands adjacent to the Site as well as on the Site itself. The latter, representing trespassers, includes ATV tracks observed on Site roads and off-road tracks. Deer and other game are hunted within and adjacent to the Site as evidenced by constructed deer blinds.

The EPA is the lead agency for the cleanup of the Site and SCDHEC is the support agency. To date, the EPA has used the Superfund Trust Fund to finance activities at the Site, including emergency response actions and performance of the RI/FS.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1. Site Operational History

The Barite Hill Mine lies within the Lincolnton-McCormick Mining District. Gold was discovered in the district in 1852 and several small mines began operating shortly thereafter (Pardee and Park, 1948; Clark, et al., 1999a). Early mines consisting of at least two shafts and small underground workings were constructed at Barite Hill at an unknown time (Clark, et al., 1999b). Following intermittent exploration activities in the 1960s to early 1980s, the property was purchased by Gwalia (USA) Ltd. in 1988. After mining began in 1991, the mine operation was turned over to Nevada Goldfields, Inc. (Clark, et al., 1999a).

Nevada Goldfields, Inc. operated the Site as an open-pit, cyanide heap leaching operation from 1991 to 1994. During that time, an estimated 64,700 ounces of gold and 119,500 ounces of silver from oxide and sulfide ore were mined (Clark, et al., 1999a).

When mining activities ceased in 1994, Nevada Goldfields began site reclamation activities and reclaimed large portions of the disturbed area (SCDHEC, 1998). Nevada Goldfields abandoned the Site in June 1999 and the State assumed control of the Site in July 1999. The Site has been inactive since that time.

The Main Pit is located at the former Barite Hill which was a small topographic high with a pre-mining elevation of about 510 feet (ft) above mean sea level (amsl; EPA, 2012). Prior to mining, topsoil was stripped and stockpiled on-site. Ore was loosened using standard drill-and-blast techniques, excavated and loaded onto haul trucks, then carried either to the ore processing facility, sub-ore stockpile, or waste rock dump. Benches cut along the mine pit walls were used as haul roads and to increase the stability of highwalls. The pit was excavated to a depth of about 340 ft amsl (Nevada Goldfields, 1993); the present maximum depth is about 368 ft amsl, approximately 55 ft below the present water elevation at full pool.

Mined ore was trucked to the processing area located in the central part of the Barite Hill Site (**Figure 2**) which hosted a crusher, agglomerator, and conveyor system. The agglomerated ore was conveyed to an asphalt-lined reusable heap leach pad for cyanide leaching or to a permanent heap leach facility in the area between the reusable leach pad and waste area C (**Figure 2**). Various process ponds were used to collect the leachate, recycle the cyanide solution and for other water management operations. Detailed descriptions of ore beneficiation (including from the Rainsford Pit), processing, water management and other operations in the other OUs are presented in the RI report for OU3 (Black & Veatch, 2015).

Wastes generated by the mining operation included waste rock (sub-ore-grade), spent ore, and process wastewater. Two large stockpiles of pyritic waste rock covering approximately 10 acres combined were left on the south and southwest sides of the Main Pit when the Site was abandoned (Gobla, 2007). The rock comprising these piles contains a large percentage of pyrite and is strongly acid generating. In part, this material may represent sulfide ore that could not be leached due to its high sulfur content. This waste rock was used to partly backfill the Main Pit during the final stages of mining (Nevada Goldfields, 1993) and likely accounts for the present elevation of the pit floor (i.e., sulfide waste rock was backfilled to raise the pit floor from the mined elevation of 340 ft to the present 368 ft amsl). The remaining portion was capped as part of the EPA's 2008 Removal Action. Runoff and seepage from the piles drained to the Main Pit.

Nevada Goldfields initiated post-mining reclamation of various disturbed areas of the Site in November 1994 (SCDHEC, 1998). Sulfide-bearing waste rock dumps on the south and southwest margins of the Main Pit were not reclaimed. Nevada Goldfields covered an unknown proportion of these waste rock piles with gunite prior to departing the Site (Gobla, 2007). The Main Pit was partly backfilled with rock from the stockpiles along its southern margin. In January 1995, a controlled discharge of 2.8 million gallons (Mgal) of process water and 0.5 Mgal of water from the treatment pond was routed to the pit following a period of high rainfall that increased solution inventories to unacceptably high levels (Nevada Goldfields, 1995). The alkaline discharge mixed with acidic water already held by the pit, thereby neutralizing both (Nevada Goldfields, 1995). Prior to abandoning the Site, June 1999, Nevada Goldfields neutralized the Main Pit, which was smaller than the present lake, with lime to a hydrogen ion concentration (pH) of 11 (SCDHEC, 2006). No other reclamation work was completed at the Main Pit. By November 2003, water in the pit had a measured pH of 2.0 to 2.2 (SCDHEC, 2006). This water was entering seeps and fractures in the pit walls where it negatively impacted groundwater.

2.2. Regulatory and Investigation History

When Nevada Goldfields abandoned the Site in June 1999, the Main Pit began to fill with water, eventually forming a lake; hereafter referred to as the Pit Lake. By 2007, the lake contained approximately 60 Mgal of water (Harrington et al., 2009) with a pH between 2.0 and 2.2 and a high content of dissolved metals; previous measurements by State personnel showed that lake pH decreased to values less than zero with depth (SCDHEC, 2007). The potential for overflow or a catastrophic release through failure of the pit wall became a serious concern as the lake level continued to rise, prompting the EPA to initiate a Time-Critical Removal Action in 2007 (EPA, 2007). In 2007, the EPA prepared an Expanded Site Inspection Report (Tetra Tech, Inc. [Tetra Tech], 2007) and a Streamlined Remedy Assessment Report (U.S. Bureau of Reclamation, 2007) for the Site.

The Removal Action included treating the Pit Lake water to near neutral pH, grading and covering waste rock dumps on the southern margin of the pit, and constructing a spillway to control the lake level. The spillway, which was cut into bedrock along the northwestern margin of the pit, was sized to limit lake level rise to 2 ft during a 100-year storm event (Harrington et al., 2009). Excess water from the top of the lake is released to the North Tributary of Hawe Creek.

The Pit Lake was treated from February to May 2008 by neutralizing with the following: 1) 1,860 tons of hydrated carbide lime, 2) 23 tons of sodium hydroxide, 3) 21 tons methanol, 4) 1,300 tons of wood chips and 5) approximately 400 tons of molasses blends. This was done to stimulate the growth of sulfate-reducing bacteria and create reducing conditions within the Pit Lake (Harrington et al., 2009). Stimulating bacterial activity promoted the formation of iron monosulfide precipitates which are considered to be more stable than iron oxyhydroxide precipitates. The precipitates settled to the bottom of the Pit Lake.

During the Removal Action, an estimated 50,000 cubic yards (cy) of strongly acid-generating waste rock was pushed below the water line along the south side of the Pit Lake. The remaining 250,000 cy of waste rock was graded to reduce the slope and capped following a Bureau of Reclamation design. The cap consisted of compacted soil and a geomembrane liner, which was covered with vegetation (Harrington et al., 2009). The liner covered most of the waste rock area as shown in Figure 1-3 (U.S. Bureau of Reclamation, 2008).

Surface water runoff from the hill slope south of the Pit Lake (including the waste rock dumps) was controlled and managed by creating a series of small sediment detention ponds and riprap lined channels that convey runoff to the Pit Lake. Work on the Removal Action was completed in October 2008.

An innovative system to monitor conditions within the Pit Lake was installed in 2009. The system was designed to provide continuous, remote monitoring of field parameters in the Pit Lake from a fixed, floating platform but system performance proved sporadic and the collected data was considered unreliable. Vertical profiles of field parameters in the Pit Lake were collected quarterly by EPA Removal Branch personnel (or their contractors). The quarterly field events were established to validate the accuracy of the data being collected by the remote monitoring system and ultimately proved the field events provided higher quality data.

The waste rock dumps were monitored by installation of monitoring wells. Two monitoring wells were installed in each of the two capped waste rock dumps (four wells total) to monitor water quality adjacent to the Pit Lake. These wells have been sampled periodically and indicate poor quality groundwater. Additional grading and seeding of the waste rock cap was conducted in 2009 and in 2010 to ensure complete vegetative cover on the cap.

The Site was placed on the NPL on April 9, 2009. Monitoring indicated that conditions within the Pit Lake were not remaining stable. Consequently, in July 2009, the Pit Lake was treated with approximately 12,000 gallons of 50 percent (%) sodium hydroxide (NaOH) solution. Another amendment with 3,500 gallons of 50% NaOH was conducted July 13- 15, 2010 (Oneida Total Integrated Enterprises [OTIE], 2010). However, the lake continued to acidify and was dosed again on August 16 and 17, 2012 with 4,000 gallons of 25% NaOH and 5,000 gallons of methanol. These amendments were mixed with lake water and discharged to the lake surface. Further monitoring of the Pit Lake continued to show acidification over this time period and the lake was dosed again April 18-20, 2016 with approximately 46,000 pounds (lbs) of NaOH.

In February 2010, the EPA contracted Black & Veatch to perform the RI/FS for the Site. Black & Veatch conducted field investigations of OU3 (North Tributary to Hawe Creek) from 2011 through 2014. This investigation is summarized in the OU3 Remedial Investigation Report, Revision 1 (Black & Veatch, 2015). Black & Veatch conducted the field investigations in OU1 between September 2014 and February 2017 which are summarized in the Remedial Investigation Report, Revision 1 (Black & Veatch, 2018a). A Feasibility Study (FS) for OU1 was finalized in April 2019 (Black & Veatch, 2019).

3.0 COMMUNITY PARTICIPATION

Site documents including the RI and FS Reports and the Proposed Plan for the Site were made available to the public on February 7, 2020 in the Administrative Record (AR) file repositories and online via the EPA Site profile page. The AR file repositories are located at the EPA Region 4 Superfund Records Center (61 Forsyth Street, Atlanta, GA 30303) and the McCormick County Library (201 Railroad Ave, McCormick SC 29835). A Notice of Availability was published in the McCormick Messenger on February 20, 2020. A public comment period on the Proposed Plan was held from February 7, 2020 – April 8, 2020. The public comment period was extended an additional 30-days to accommodate an extension request received during the Proposed Plan meeting held at the McCormick County Administration Building (610 S. Mine Street, McCormick SC 29835) on March 5, 2020. During the meeting the EPA presented a description of the Proposed Plan and schedule for remedy implementation and allowed nearby residents and interested parties to comment and ask questions of EPA officials.

Approximately 35 people attended the meeting; a transcript of the meeting is included as Appendix A.

There were a number of comments and questions received during the Proposed Plan meeting and representatives from EPA and SCDHEC provided responses during the meeting. EPA responses to written comments received during the comment period are included in the Responsiveness Summary, Part 3 of this ROD.

4.0 SCOPE AND ROLE OF OPERABLE UNIT

As with many Superfund sites, the problems at the Barite Hill Site are complex. As a result, the EPA has organized the response action work into five operable units (OUs):

- OU1 – Barite Hill Main Pit Lake System
- OU2 – Overburden and Bedrock Groundwater
- OU3 – North Tributary to Hawe Creek
- OU4 – Southwest Tributary to Hawe Creek
- OU5 – Hawe Creek

Previous investigations of the Site revealed extensive surface water and sediment contamination in OU3. Consequently, the EPA conducted a Remedial Investigation (RI) for OU3 (Black & Veatch Special Project Corp. [Black & Veatch], 2015) to evaluate contaminant migration pathways, and nature and extent. Since it was determined that contaminated Pit Lake water and OU1 groundwater migrates to OU3 via fractures and seeps and/or over the Pit Lake spillway, the top priority is to develop remedial alternatives that will prevent or control source contaminant migration to OU3.
It is expected that an interim remedy for OU1 will reduce toxicity, mobility and volume (T/M/V) of contaminants in OU3 and that after source controls in OU1 have been implemented, water and sediment quality in OU3 will subsequently improve. This sequential approach provides the means to monitor the seeps and the North Tributary to Hawe Creek as a result of actions in OU1.

This ROD presents an interim CERCLA remedial action for OU1 at the Site. OU1 has been divided into three distinct CMZs, all of which are being addressed under this ROD. These CMZs are the Pit Lake, Waste Rock, and OU1 Groundwater.

The Interim Remedy in this ROD, will neither be inconsistent with, nor preclude, implementation of the final remedy. The Interim Remedy will achieve the overall goal of mitigating contamination that is a source of surface water and groundwater contamination and treat contaminants of concerns to levels that do not present an unacceptable risk to human and ecological receptors. The Interim Remedy is compatible with the planned and existing use of the Site.

5.0 SITE CHARACTERISTICS

5.1. Conceptual Site Model

Conceptual Site Models (CSMs) illustrate the physical, chemical, and biological relationships between contaminant sources and affected resources. As such, they provide a basis for interpreting contaminant fate and transport in the environment and the assessments of risk to human and ecological receptors.

For ease of display, the CSM for the Pit Lake is divided into four aspects that together control or influence contaminant behavior in the lake (see Castendyk, 2009). These are the geological, geochemical, hydrological, and limnological CSMs displayed on **Figures 3 to 6**. Details of the contaminant release mechanisms, migration routes and other factors are described in the following sections. The CSMs are displayed on schematic cross- sections oriented north-south and east-west through the Pit Lake; these cross-sections are not drawn to scale.

Figure 3 depicts the influence of sulfide-rich acid generating waste rock that has been placed into the pit and that remains partly covered on the south shore of the pit.
The surrounding bedrock varies from mineralized to slightly mineralized with variable amounts of sulfide minerals. The pit highwall on the east side consists of mineralized bedrock that ranges from intensely oxidized to partly oxidized with relict sulfide phases and secondary, water soluble salts.

Figure 4 depicts various geochemical exchanges that occur between the Pit Lake water column and inputs from and losses to the atmosphere, groundwater, and surface water; and diffusion and precipitation/adsorption between lake water and sediment and saturated waste rock.

Figure 5 illustrates dominant hydrological processes. These include precipitation and evaporation, inputs from groundwater and storm runoff, and groundwater loss to the fractured bedrock. Short and long-term precipitation and evaporation provide significant controls on discharge from the Pit Lake, and impact surface water flow across the spillway. While loss to bedrock fractures provides seepage to the North Tributary.

Figure 6 depicts seasonal mixing within the oxygenated upper layer of the lake and the isolation of the lower water layer (>45 ft depth) which remains generally anoxic and does not mix into the upper layer.

Mass gain to the Pit Lake is depicted as stormwater runoff to the Pit Lake from the pit walls, the waste rock cap and other upslope areas; the inflow of groundwater from waste rock dumps on the south shore of the lake and from mineralized to non-mineralized bedrock surrounding the Pit Lake; diffusion and exchange with submerged waste rock and sediments; and direct precipitation. Mass loss is shown as overflow discharge from via the emergency spillway; seepage loss to the fractured bedrock; precipitation of minerals on the substrate of the Pit Lake; and evaporative loss to the atmosphere. Contaminants are transported through the environment by surface water flow, sediment transport, and groundwater flow through fractured metamorphic bedrock.

5.2. Overview of the Site

The Site is surrounded by forested and agricultural land and rural residential areas. No buildings, homes or commercial facilities are located within a 0.25-mile radius of OU1.

Of the 795-acres, approximately 135 acres have been disturbed by historic and modern mining. The remaining property serves as an undisturbed buffer zone in a natural state. Gold and silver mining operations occurred between 1991 and 1994.

5.2.1 Geologic, Hydrogeologic, and Topographic Information

The Site is situated within the Piedmont physiographic province of South Carolina just south of the town of McCormick. The gently rolling terrain is bisected by moderately incised stream valleys. Elevations vary from about 500 ft to 350 ft amsl. The area drains to the west-southwest via tributaries to Hawe Creek toward Lake Strom Thurmond (Clarks Hill Lake).

Soils at the Site are those characteristic of upland terranes which have a silty surface layer that overlies clayey subsoil (Camp and Herren, 1980). Camp and Herren identified two soil series which are derived from Carolina Slate Belt rocks in the area. Soils of the

Tatum-Goldston-Nason series are moderately permeable, well- to excessively well-drained soils on sloping to steep terrane. They consist of an upper brown silt loam that overlies red clay to silty clay loam. Soils of the Georgeville-Herndon-Kirksey series are moderately permeable, moderately well- to well-drained soils on gently sloping terrane. They consist of an upper brown silt loam that overlies red silty clay.

Rocks comprising the Site are part of the Carolina Slate Belt, which extends from southern Virginia southwest into Georgia. The Slate Belt is primarily composed of intermediate-grade metamorphic rocks of Neoproterozoic to middle Cambrian age (Clark et al. 1999b; Hibbard et al., 2002). The belt is bounded on the west by igneous and high-grade metamorphic rocks of the Charlotte Belt, and on the east by an extensive zone of ductile shearing and mylonitization (Modoc Fault; Clark et al., 1999a).

The Barite Hill deposit occurs within a stratigraphic assemblage of the Persimmon Fork Formation consisting of the basal Lincolnton metadacite conformably overlain by a northeast-trending sequence of metamorphosed felsic volcanic, intermediate volcanic, felsic volcaniclastic, and clastic metasedimentary rocks (Clark et al., 1999b). These rocks were formed in an island arc setting.

The Lincolnton metadacite (Clark et al. refer to this unit as a metarhyolite) is an intrusive-extrusive complex (Clark et al., 1999a). It contains characteristic blue quartz phenocrysts within a quartz-feldspar matrix (Clark et al., 1999a). Where observed in drill core from the Site (monitor well BH-67), the unit is light gray, foliated, and biotite-bearing; fine-grained (<1 millimeter [mm]) pyrite crystals comprise less than 1% of the rock.

The Persimmon Fork Formation in the Barite Hill area comprises a series of felsic to intermediate composition metatuffs that Clark et al. (1999a,b) divided into the upper and lower pyroclastic units. The units are distinguished by the appearance of interbedded metasedimentary rocks in the upper unit. The lower unit, which hosts the Barite Hill gold-silver mineralization (Clark et al., 1999b), consists of fragmental tuffs which, in drill core from monitor well BH-67, includes subangular fragments of gneiss and granite to 3 centimeters (cm) enclosed in light-gray, biotite-bearing schist. Both units include stringers and disseminations of pyrite. The felsic and intermediate volcanic and felsic volcaniclastic rocks display a well-developed foliation that generally strikes N50-55E and dips 70-80° NW (Clark et al., 1999b; Gobla, 2007). Locally preserved bedding planes are oriented similarly to the foliation (Clark et al., 1999b).

Clark et al. (1999a) and Foley and Ayuso (2012) interpreted the Barite Hill deposit as having formed through submarine hot spring exhalations and hydrothermal alteration in an active volcanic area. This formed a series of four stratigraphically bounded, lenticular zones of mineralization within the lower pyroclastic unit at the Main Pit (referred to as the footwall, middle, hanging wall, and Red Hill zones). Initial mineralization deposited base-metal sulfides and barite; a subsequent period of mineralization deposited precious metals under epithermal (50-200 degrees Celsius [°C]) conditions. Most gold-silver mineralization occurs within zones of siliceous breccia (Clark et al., 1999a).

Gold occurs as microscopic grains of native metal, alloyed with silver (electrum), and as a telluride mineral (sylvanite; Clark et al., 1999a). Silver was found in its native state, as electrum, as a sulfide (argentite), as telluride and selenide minerals, and dissolved in galena (lead sulfide; Clark et al., 1999a). In addition to pyrite, various other base metal minerals were identified at the site including those of copper (chalcopyrite, chalcocite, bornite, and tennantite), zinc (sphalerite), lead (galena), and bismuth (Clark et al., 1999a,b). In the near-surface environment, the sulfide deposits were weathered and oxidized to form a hematite gossan. Pyrite and other base metal sulfides were largely removed from the oxidized zone while precious metals remained (Clark et al., 1999a); oxidized ore was the primary target of the Barite Hill mining operation. At depth below the weathering zone, pyrite comprised from 5 - 45% of the mineralized zones (Clark et al., 1999a). Pyrite also occurred throughout non-ore rock, typically in amounts less than 5%.

Following deposition of the ore minerals, rocks of the Persimmon Fork Formation were regionally metamorphosed, folded, and sheared as the island arc collided with, and was attached to, North America during the Acadian Orogeny. As a result, the Barite Hill deposit lies stratigraphically below an overturned contact between the upper and lower pyroclastic units (Clark et al., 1999a). Most metallic minerals, quartz, and pyrite were remobilized and recrystallized along cleavage planes during this deformation (Clark et al., 1999a). The ore body was subsequently offset along high-angle faults, possibly during Mesozoic rifting (Clark et al., 1999a).

Figure 3 illustrates general features of the structural geology in the area of the Main Pit, including northeast-trending high-angle fracture zones exposed in the northern wall of the Main Pit and in bedrock outcrops along the North Tributary (Harrington et al., 2009), three moderate- to high-angle oblique slip faults which cut the Main Pit with general 290° to 295° azimuth trends (Nevada Goldfields, 1994; Clark et al., 1999b), and the footwall ductile shear zone which trends about 45° azimuth and is offset by the oblique-slip faults (Nevada Goldfields, 1994). Measurements of fractures along the walls of the Main Pit suggest a dominant 40° to 60° azimuthal orientation with a secondary fracture set oriented at 310° to 330° (TN & Associates, 2008).

5.3. Sampling Strategy

Multi-media sampling was guided by the CSMs that were refined as understanding of the Site increased over time. Samples were collected from 2008 to 2018 and evaluated to determine the nature and extent of soil, sediment, surface water and groundwater contamination, support assessment of risks, improve hydrogeologic understanding, and evaluate potential remedy alternatives and treatment options.

5.4. Known or Suspected Sources of Contamination

Contaminants from the waste rock dumps are transported to groundwater by infiltrating rainwater that leaches contaminants, and by groundwater that gains contaminants as it flows through the waste rock piles from up-gradient areas of the Site.

Waste rock submerged beneath the Pit Lake provides a direct connection to surface water through diffusive and advective exchange between the lake and water contained within the saturated waste rock backfill. Water contained within the waste rock has high total dissolved solids (TDS) and a density significantly higher than the water column of the Pit Lake; consequently, it is expected to flow into the Pit Lake as a density current along the floor of the Pit Lake causing it to settle in the deepest portions of the lake. Geochemical relations suggest that the lower water layer in the Pit Lake is derived from waste rock dump water and forms a stagnant pool that does not participate in circulation or turnover that occurs in the upper layer above the chemocline. Instead, the upper and lower water layers are likely to interact along the chemocline boundary primarily by diffusive exchange and limited mixing induced by advective transport in the upper layer.

Contaminants in the pit walls migrate to surface water and sediment in the Pit Lake during rainfall-runoff events which leach contaminants (including oxidation products and intermediate metal salts) and entrain particles. Pit walls are a significantly smaller source than the waste rock dumps. Contaminants also migrate from the pit walls by direct contact with wall rock and potentially through physical instability of the steep pit walls.

Contaminated sediment larger than silt is unlikely to migrate when the surface of the Pit Lake is below the elevation of the emergency spillway. However, during times when water flows across the spillway, increased water velocity may entrain sediment from the substrate near the spillway and convey it downstream as a particulate load. Chemical precipitates present as colloids and contaminants sorbed to small particles such as clay minerals may remain suspended in the water column and be released from the Pit Lake by flow across the spillway.

Contaminated surface water within the Pit Lake is a secondary source which affects sediment resources within the lake, groundwater resources within OU1 down-gradient of the Pit Lake, and surface water resources in the North Tributary and Pit Branch (OU3). Contaminants in the Pit Lake migrate directly to surface water in the North Tributary by discharge across the spillway.

Pit Lake contaminants migrate to groundwater through fractures in the bedrock walls and base of the mine pit. Flow to groundwater is expected to be anisotropic across the pit occurring primarily where geologic fractures (faults and joints) are present. The speed and volume of migration is anticipated to be a function of fracture length and aperture and hydraulic pressure gradients. Although historical blasting to loosen rock for excavation would create fractures on most pit wall surfaces, these fractures are expected to advance only a few meters into the bedrock.

The quality of water migrating from the Pit Lake depends on the depth within the lake from which water escapes. Water in the upper water layer has significantly lower contaminant concentrations and is less dense than water in the lower water layer. Water that discharges across the spillway is sourced from the upper water layer; water that escapes to groundwater may be sourced from either the upper or lower pit water layers.

5.5. Nature and Extent of Contamination

The extent of contamination of the COCs identified by the RI and risk assessment processes is summarized below for each environmental medium.

5.5.1 Soil Contamination

Soil samples (0 – 6 inches depth) were collected around the Pit Lake in May 2011 from six locations. Five reference background soil samples were also collected for the entire Barite Hill Site. The soil samples were compared to soil quality screening benchmarks for human and ecological receptors. No organic chemicals exceeded screening levels. However, elevated concentrations of arsenic, barium, cadmium, chromium, copper, and lead were identified to be of potential concern with some elevations of antimony, iron, manganese, molybdenum and vanadium. Most of these metals are only slightly elevated above twice the background soil concentrations. No soil contamination patterns, trends, or multiple contaminant hotspots were identified in this naturally mineralized area.

5.5.2 Groundwater Contamination

During the RI and FS, groundwater analysis included total metals and classical parameters/nutrients in the 15 wells within OU1 (**Figure 7**). Samples for organic compounds (VOCs, SVOCs, Pesticides, and PCBs) were collected from selected wells during two of the sampling events. Concentrations of metals above the Safe Drinking Water Act (SDWA) primary drinking water standards, (i.e., maximum contaminant levels (MCLs)) have occurred during most sampling events (2011 to 2018). These metals included antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, selenium, and thallium. The highest concentrations of metals have been detected in the samples from the four wells installed within the waste rock area (BH26 through BH29). Exceedances of MCLs have also occurred in wells down-gradient of the Pit Lake (BH55, BH56, and BH64). The concentrations of these metals have remained relatively stable throughout the monitoring period. Groundwater upgradient of the Pit Lake (BH49, BH50, BH51, BH66, BH71, BH72, and BH73) have very few exceedances.

5.5.3 Sediment Contamination

A total of six sediment samples were collected from the Pit Lake during the RI; three in May 2011 and three in July 2016. Samples were analyzed for total metals, total and weak acid dissociable cyanide, paste pH, sulfur forms and acid-base accounting. Only one sample was analyzed for organic constituents. In addition, the 2016 samples were submitted to the Department of Geosciences at Virginia Tech for mineralogical analysis by X-ray diffraction (XRD) and scanning electron microscopy. The sediment concentrations were compared to screening-level benchmarks considered protective of human and ecological receptors. No organic chemicals exceeded the benchmarks.
The primary metals of concern in sediment are barium, cadmium, copper, iron, lead and zinc. Primary crystalline phases identified by XRD included the clay mineral kaolinite, muscovite mica and quartz. One sample also contained minor amounts of gypsum.
Iron oxide or sulfide phases were not identified by XRD. Other minor carbonate, sulfide and/or sulfate minerals were identified and heavy metals (e.g., cadmium, copper, zinc) were also associated with some particles.

5.5.4 Surface Water Contamination

A variety of surface water data exists for the Pit Lake. EPA's Superfund Technical Assessment and Response Team (START) contractor collected laboratory and field analytical data in the lake from 2008 through 2013 related to actions to neutralize the lake; amendments were added to the lake in 2008, 2009, 2010, 2012 and 2016.
In addition to the analytical data collected by START, numerous field parameters were collected by hand-lowering multi-probe sondes to measure temperature, specific conductivity, pH, oxidization-reduction potential (ORP), dissolved oxygen (DO) and turbidity. These data were generally collected at one-meter intervals from the surface to the bottom. The EPA Science and Ecosystems Support Division (SESD) and Black & Veatch continued to monitor the lake from May 2011 through November 2016. For each sampling event, analytical parameters were collected at different depths, generally in the upper 10 feet, the middle water column (15 to 25 feet) and near the bottom (>40 ft). Parameters sampled during most events included total and dissolved metals, chloride, sulfate, acidity, alkalinity, TDS, total suspended solids (TSS), total and ferrous iron

concentrations, and total organic carbon (TOC). Stormwater runoff samples were also collected from 4 locations around the pit including the highwalls.

Pit Lake water quality was compared to screening level water quality benchmarks such as South Carolina water quality standards and human health benchmarks. The comparison indicated that cadmium, copper, and manganese exceeded their benchmark values with the greatest frequency and magnitude. Other COCs in the lake include aluminum, arsenic, barium, cobalt, iron and zinc. The highest concentrations are generally near the lake bottom.

6.0 CURRENT AND POTENTIAL FUTURE LAND AND WATER USES

6.1 Land Uses

The Site is unoccupied and not currently in use. The former mining area is bordered by a discontinuous barbed wire fence; a locked chain link gate is present at the main road entrance to the Site. The immediate surrounding area is rural, undeveloped and sparsely populated. No buildings, homes or commercial facilities are located within 0.25 mile of OU1. Future land use is expected to be recreational.

Signs of recreational all-terrain vehicle (ATV) use have been observed in the past on lands adjacent to the Site as well as on the Site itself. The latter, representing trespassers, includes ATV tracks observed on Site roads and off-road tracks. Deer and other game are hunted within and adjacent to the Site as evidenced by constructed deer blinds.

6.2 Ground and Surface Water Uses

Groundwater at the Site is currently classified as Class II (potential drinking water source) and is not being used for any purpose. Most homes and businesses in the area surrounding the Site obtain their drinking water from a public (or municipal) water supply. A private groundwater well survey conducted in 2004 indicated that no wells were identified in the immediate area of the Site, however in 2011 EPA performed an additional well survey. During the survey, private groundwater wells were identified on Jefferson Street to the east, and Greenfield Road to the south and west. During September and November 2011, EPA Region 4's Science and Ecosystem Division (SESD) collected samples from the wells. No site related contaminants were identified in the samples collected. In addition, no public supply wells were located within a 4-mile radius of the Barite Hill Site (ATSDR, 2011).

Surface water overland flow at the Site is directed down the slopes and out of the Site's drainage area through defined drainage courses in the topography and constructed diversion ditches. The most significant surface water drainage features at the Site are two unnamed perennial tributaries to Hawe Creek referred to as the North (OU3) and Southwest (OU4) Tributaries. The drainage divide between these streams follows the ridge from the main gate to the process plant area. Hawe Creek discharges to Lake Strom Thurmond along the Savannah River approximately 2 miles downstream of the Site. The only known fishing occurs where Hawe Creek enters Lake Strom Thurmond.

7.0 SUMMARY OF SITE RISKS AND BASIS FOR ACTION

The interim action selected in this ROD is necessary to protect public health and the environment from actual or threatened releases of hazardous substances, contamination and pollutants into the environment. The human health risk assessment (HHRA) is contained in the Barite Hill/Nevada Goldfields Site OU1 Remedial Investigation Report, Revision 1 (Black & Veatch, 2018a). The Baseline Ecological Risk Assessment (BERA) is also contained in the Remedial Investigation Report and is summarized in Section 7.2.

7.1 Summary of the Human Health Risk Assessment

A summary of the HHRA for the Site completed in May 2018 (Black & Veatch, 2018b) is provided in the following subsections.

7.1.1 Identification of Chemicals of Concern

The HHRA evaluated exposure to surface soil, sediment, surface water, and groundwater based on data collected from 2011 through 2016.

The identification of COCs was conducted in accordance with EPA Region 4 Human Health Risk Assessment Supplemental Guidance.

The COCs identified in the HHRA in soil, surface water, and groundwater in OU1 are listed in **Tables 1 through 3**. The COCs consist of inorganic chemicals (metals).

7.1.2 Exposure Assessment

Based on an understanding of the fate and transport properties of the contaminants, and the potential for human contact to the affected media, the receptors evaluated included residents, trespassers, industrial/commercial workers, and construction workers. **Figure 8** presents the human health CSM developed for the HHRA.

Potentially complete exposure pathways examined for soil, groundwater, sediment and indoor air were:

- Ingestion of soil/sediment/surface water/groundwater
- Dermal contact with soil/sediment/surface water/groundwater
- Inhalation of particulates from surface soil

Note that only risks and hazards for exposures to surface soil, surface water, and groundwater are presented in this summary as they represent the greatest potential risk and justify implementation of the selected remedy. The risks and hazards associated with the other current and future receptors/media combinations can be found in the HHRA. The exposure point concentrations (EPCs) for the COCs in each media were calculated in accordance with EPA Region 4 Human Health Risk Assessment Supplemental Guidance and are summarized in **Tables 1 through 3**.

7.1.3 Toxicity Assessment

The purpose of the toxicity assessment is to identify the types of adverse health effects that a COC may potentially cause to define the relationship between the dose of a compound and the likelihood and magnitude of an adverse effect (response). Adverse effects are characterized by the EPA as carcinogenic and non-carcinogenic. Dose-response relationships are defined by the EPA for oral and inhalation exposures. Oral dose-response values were used to derive appropriate dermal toxicity values.

The dose-response assessment evaluates the available toxicity information and quantitatively describes the relationship between the level of exposure (either from animal or human epidemiological studies) and the occurrence of an adverse health effect.

This relationship is described by a cancer slope factor (CSF) or unit risk factor (URF) forcarcinogens and a reference dose (RfD) or reference concentration (RfC) for systemic toxicants, collectively called toxicity values.

The most current toxicity values were obtained from the following hierarchy of sources in accordance with the EPA Office of Superfund Remediation and Technology Innovation (OSRTI; EPA, 2003):

- Tier 1 - IRIS.
- Tier 2 - Provisional Peer-Reviewed Toxicity Values (PPRTVs).
- Tier 3 – Other (Peer Reviewed) Values, including: Agency of Toxic Substances and Disease Registry (ATSDR), Minimal Risk Levels (MRLs); California Environmental Protection Agency (CalEPA) values; values from Appendices to the PPRTV support documents (PPRTV-A); and Health Effects Assessment Summary Tables (HEAST).

Tables 4 and 5 summarize the toxicological criteria that are applicable for each COC of the exposure pathways evaluated in the HHRA.

7.1.4 Risk Characterization

The objective of the risk characterization for the HHRA was to integrate the exposure and toxicity assessments into quantitative and qualitative expressions of risk. The risk characterization is an evaluation of the nature and degree of potential carcinogenic and non-carcinogenic health risks posed to current and future receptors at OU1 of the Site. The potential for carcinogenic effects were limited to only those chemicals classified as carcinogens, while both carcinogenic and non-carcinogenic chemicals were evaluated for potential non-carcinogenic effects.

To characterize the overall potential for non-carcinogenic effects associated with exposure to multiple chemicals, the EPA uses a Hazard Quotient (HQ) approach. This approach assumes that simultaneous sub-threshold chronic exposures to multiple chemicals that affect the same target organ are additive and could result in an adverse health effect. The HQ is calculated as follows (EPA, 1989):

$$HQ = DI/RfD$$

Where:

HQ = Hazard Quotient (unitless)
DI = Daily Intake (mg/kg/day for oral and dermal)
RfD = Reference Dose (mg/kg/day)

or, for inhalation exposures:

$$HQ = EC/RfC$$

Where:

EC = Exposure Concentration (mg/m^3)
RfC = Reference Concentration (mg/m^3)

All of the HQ values for chemicals within each exposure pathway are summed to yield the hazard index (HI) for that pathway. Each pathway HI within a land use scenario (e.g., future worker) is summed to yield the total HI for the receptor. The total HI represents the total of the HQs of all COPCs in all pathways, media, and routes to which the receptor is exposed. If the total receptor HI exceeds 1, then more precise HIs were developed for each target organ and/or toxic effect. These target organ-based HIs were then used to form the basis for the COC selection. If the value of the total target HI is less than 1, it is interpreted to mean that the risk of non-carcinogenic injury to that target organ is low. If the total target organ HI is greater than 1, it is indicative of some degree of non-carcinogenic risk, or effect, and COCs contributing to that target organ HI are selected (EPA, 2014). COCs are those COPCs that contribute a HQ of 0.1 or greater to any pathway evaluated for the use scenario.

The incremental risk of developing cancer from exposure to a chemical at OU1 of the Site is defined as the additional probability that an individual exposed will develop cancer during his or her lifetime (assumed to be 70 years). This value is calculated from the average daily intake over a lifetime (CDI) and the SF for the chemical as follows (EPA, 1989):

$$\text{Risk} = \text{CDI} \times \text{SF}$$

Where:

Risk = Lifetime Cancer Risk (unitless)
CDI = Chronic Daily Intake (mg/kg/day for oral and dermal)
SF = oral or dermal slope factor $(mg/kg/day)^{-1}$

or, for inhalation exposures:

$$\text{Risk} = \text{EC} \times \text{IUR}$$

Where:

EC = Exposure Concentration ($\mu g/m^3$)
IUR = Inhalation Unit Risk $(\mu g/m^3)^{-1}$

The risk of adverse non-carcinogenic effects from chemical exposure is expressed in terms of the HQ. The HQ is the ratio of the estimated dose (daily intake [DI]) that a human receives to the RfD, the estimated dose below which it is unlikely for even sensitive populations to experience adverse health effects. The HQ is calculated as follows (EPA, 1989):

$$HQ = DI/RfD$$

Where:

HQ = Hazard Quotient (unitless)
DI = Daily Intake (mg/kg/day for oral and dermal)
RfD = Reference Dose (mg/kg/day)

or, for inhalation exposures:

Where: $HQ = EC/RfC$

EC = Exposure Concentration (mg/m^3)
RfC = Reference Concentration (mg/m^3)

Tables 6 through 11 present a summary of the unacceptable cancer risks and non-cancer hazards identified in the HHRA associated with exposure to the COCs in soil, sediment, surface water and groundwater. Potential receptors and potentially complete exposure pathways were identified for both current and future land uses. The future use of the Site and surrounding area is not expected to change. However, the HHRA assumed that additional exposure pathways to Site media could be complete under future land use conditions. In summary, the following scenarios were identified:

- Current/future Trespasser / Recreational user exposed to surface water
- Current/future Industrial / Commercial Worker exposed to groundwater
- Current/future Construction Worker exposed to groundwater
- Future Resident exposed to surface water and groundwater

The HHRA indicate that excess lifetime cancer risks for current and potential future Trespasser/Recreational user and Construction Worker exposed to soil, sediment, surface water and groundwater are within the EPA's acceptable excess lifetime cancer risk range of 10-6 (one in a million) to 10-4 (one in ten-thousand). The HHRA indicate cancer hazards exist for a future Resident and current/future Industrial/Commercial Worker exposed to Site groundwater. The primary driver for cancer hazards associated with exposure to groundwater water is arsenic.

Non-cancer hazards were acceptable (HIs < 1) for all receptors exposed to soil and sediment.

However, non-cancer hazards were unacceptable (HIs > 1) for current and potential future Industrial/Commercial Worker, Construction Worker and Residents exposed to groundwater. The primary drivers for non-cancer hazards associated with exposure to groundwater are aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium and zinc.

Non-cancer hazards were also unacceptable for current and future Trespasser/Recreational users and future Residents exposed to surface water. Manganese is the primary COC for non-cancer hazards associated with exposure to surface water.

7.1.5 Uncertainties

The calculations presented in the HHRA are meant to assist the EPA remedial project manager with information on which to base risk management decisions. A combination of site-specific exposure information, standard default assumptions, and professional judgment were used to select exposure units and develop exposure assumptions for the various receptors evaluated in the HHRA. These exposure assumptions are conservative and are likely to overestimate hazards and risks.

7.2 Summary of the Ecological Risk Assessment

An Ecological Risk Assessment (ERA) for the OU1 was completed as part of the RI (Black & Veatch, 2017). The ERA evaluated data collected from 2011-2015. The ERA evaluated existing and potential adverse ecological impacts posed by hazardous substances within OU1. The ERA evaluated risks to aquatic organisms in the Pit Lake and to sensitive terrestrial organisms (mammals and birds) around OU1. **Figure 9** presents the ecological CSM developed for the ERA.

7.2.1 Risks Estimates to Aquatic Organisms

Water and sediment quality in the Pit Lake would pose a severe risk to aquatic life if it was present. There is no viable traditionally recognized aquatic community in the Pit Lake (i.e., no fish or benthic community). The lake ecosystem is comprised of biofilms dominated by specialized microbial and algal forms along the shallow portions of the lake shore. The pH of the lake has varied from approximately 1.7 to 7.3 depending on water depth, season, and time after periodic neutralization treatments of the pit water.

The Pit Lake continues to acidify and mobilize high concentrations of metals into the water column despite several attempts to control the acidity. This results in extreme toxic effects to most organisms. As long as contaminated groundwater continues to enter the Pit Lake, existing chemical processes will not allow for slow natural recovery to circa-neutral conditions.

Pit Lake water discharging into the North Tributary (OU3) could result in a risk to aquatic organisms within the OU3. COCs for Pit Lake water discharging into OU3 include: aluminum, iron, cadmium, and copper (Table 13).

7.2.2 Risk Estimates to Terrestrial Organisms

There is some growth of emergent macrophytes such as cattails in localized shore areas and some use in these areas by semi-aquatic insects. Waterfowl occasionally visit the vegetated slopes but do not utilize the lake for lack of a food base. Wildlife such as deer and raccoon temporarily visit the accessible areas of the lake at the spillway and the southeast shoreline. Frogs temporarily inhabit the erosion check dams and may reside near the lake edge as well. Exposures to wildlife from direct contact and ingestion of surface water and shore sediments may be on a daily basis and would pose a risk.

Small mammals such as mice and voles likely inhabit the revegetated mine dump areas and deer may graze on the clovers.

COCs within the Pit Lake water that pose a risk to wildlife using this as a daily water source include: aluminum, copper, and iron.

7.2.3 Uncertainties

Major uncertainties include: 1) the assumption that the Pit Lake is an aquatic resource to be protected when it never has been a designated water body in need of protection, 2) the assumption that lake sediment provides habitat for benthic organisms when it does not, 3) that the Pit Lake provides the sole source of drinking water for wildlife; and 4) reliance on very conservative soil benchmarks to evaluate potential effects to terrestrial receptors.

7.2.4 ERA Conclusion

The ERA concluded that: 1) water quality in the Pit Lake would pose a severe risk to aquatic life if it was present; 2) sediment quality in the lake would pose a risk to benthic organisms if they were present; 3) if acidity could be controlled at pH >6, and if aquatic resources were introduced into the Pit Lake, then a viable aquatic community may become established; 4) soil quality does not pose an adverse risk to terrestrial receptors; 5) contaminated groundwater in OU1 that discharges via seeps to OU3 has resulted in significant risks to aquatic life in the upper reaches of the North Tributary; and, 6) Pit Lake water poses a risk to wildlife which may use it as a daily drinking water source.

7.2.5 Basis for Action

It is the EPA's current judgment that the Preferred Alternative identified in this IROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Water flows into the Pit Lake as direct precipitation, rainfall runoff from the highwalls, stormwater that is shed from the capped waste rock and sedimentation pond area south of the lake and groundwater inflow from the southeast and southwest, including water entering from the capped waste rock area.

Rainfall runoff from oxidized to partly weathered highwalls contribute metals to the Pit Lake in total and dissolved forms. The concentrations of dissolved metals, specifically copper, are higher from areas that have remnant sulfide mineralization. They are slightly acidic (pH 4.7 to 5.2) with low concentrations of sulfate.

Storm runoff conveyed to the lake from upslope areas contains dissolved metals including copper in concentrations lower than runoff from the sulfide-bearing highwalls and small amounts of alkalinity.

Relatively clean groundwater migrating from the south, becomes contaminated with metals after interacting with the capped waste rock or natural mineralization before discharging into the Pit Lake. Groundwater flowing toward the Pit Lake from the southeast is alkaline with low concentrations of metals. Groundwater also discharges from the lake through seeps to the North Tributary to Hawe Creek. Restoration of Site groundwater and restoration of surface water within the Pit Lake is not within the scope of this source control remedy for OU1. The Pit Lake is a former mine pit and was previously utilized as a treatment system and thus has been determined not to be waters of the U.S. The primary risk associated with the Barite Hill Site involves the migration of Site-related contaminants to OU3 and ecological risks to wildlife drinking from the Pit Lake.

Because the OU1 portion of the Site was reclaimed by placing waste rock back into the Pit Lake and installing a cap over the graded waste rock, future residential use of this land is unlikely. Given the surrounding wooded nature of the Site and proximity to the town of McCormick, recreational use would be a likely future land use following closure, however private parties have also expressed an interest in re-mining the site.

The Baseline Ecological Risk Assessment (BERA) results indicate that aquatic invertebrates and most phytoplankton species would be unable to survive in the Pit Lake. Risks exist to wildlife that ingest all of their water from the Pit Lake and cadmium and copper concentrations in Pit Lake sediments would pose a risk to benthic communities, if they existed. Copper in OU1 soils poses some risk to ecological receptors.

Lifetime cancer risks exist for future Residents, and current and potential future Industrial/Commercial Workers exposed to groundwater, and non-cancer hazards were unacceptable for current and potential future Industrial/Commercial Workers, Construction Workers and Residents exposed to groundwater. Non-cancer hazards were also unacceptable for current and future Trespasser/Recreational users and future Residents exposed to surface water.

8.0 REMEDIAL ACTION OBJECTIVES

To satisfy the requirements of CERCLA and based on previous Site investigations, Remedial Action Objectives (RAOs) have been developed for the Site. RAOs provide general descriptions of what the cleanup is expected to accomplish. Derived from the CSM, RAOs address the significant exposure pathways and risks associated with surface water, groundwater, soil/waste rock, and sediment contaminants. RAOs and cleanup levels should reinforce each other, leading to the selection of a remedial action that meets the NCP threshold criteria by being protective of human health and environment (HH&E) and meeting ARARs, while also providing the best balance among the remaining NCP criteria. The RAOs which were used to guide the development of remedial alternativesare listed below. The general remedial strategy for OU1 is source control to mitigate effects of contaminant releases from OU1 to OU3 and the need to restore and protect the designated uses for the North Tributary (OU3).

Surface Water and Sediment in the Pit Lake

- Minimize leaching from contaminated Pit Lake sediments to groundwater and surface water
- Minimize benthic organism exposure to COCs in sediments exceeding levels protective of ecological risk
- Prevent exposure to COCs in surface water above protective levels for human health

Groundwater

- Prevent or control the migration of contaminated groundwater to the Pit Lakeand/or to seeps that discharge to the North Tributary

- Prevent unacceptable risks associated with potential future human exposure to contaminated groundwater above health-based standards and/or risk-based concentrations for drinking water

Soil/Waste Rock

- Prevent exposure to ecological receptors from COCs in soils above acceptable risk-based levels
- Prevent or control migration of contaminants in soil or waste rock to groundwater

Cleanup levels for the protection of human health and ecological receptors are presented in **Table 13**.

9.0 DESCRIPTION OF ALTERNATIVES

To develop and focus the remedial alternative evaluation process in the FS, the Site was segregated into three CMZs. A CMZ represents a portion of the Site contamination which has a particular characteristic that defines the optimal remediation approach. Defining characteristics can include one or more parameters such as lithology, COCs, depth, and/or areal extent. Segregation of the Site into CMZs allows remedial alternatives to be tailored to these conditions, thereby resulting in a more economical and focused remedy. CMZs have been established to address contaminants in the Pit Lake (CMZ-1), capped waste rock (CMZ-2), and OU1 groundwater (CMZ-3). The CMZs are established based on existing data and may require refinement if additional data is collected in the future. A detailed screening and comparative analysis of the potential remedy alternatives is included in the Feasibility Study Report, Revision 1, located in the information repositories at the McCormick County Library in McCormick, SC and EPA's Records Center in Atlanta, GA.

9.1 Description of the Pit Lake (CMZ-1) Remedial Alternatives

The alternatives for the Pit Lake (CMZ-1) address the surface water within the Pit Lake as well as the submerged waste rock. None of the individual alternatives for the Pit Lake will meet all of the proposed OU1 RAOs. A combination of the best individual alternatives designed will be required to meet all of the proposed RAOs. The four remedial alternatives developed for the Pit Lake are described in the following sections.

9.1.1 Pit Lake Alternative 1: No Action

Estimated Capital Costs: $0
Estimated Annual Operation and Maintenance (O&M) Costs: $94,160
Estimated Present Worth Costs: $94,200
Estimated Time to Achieve RAO/Cleanup Levels: N/A

Section 300.430(e)(6) of the NCP directs that a "No Action Alternative" be evaluated to provide a baseline scenario to compare all other alternatives against. The No Action Alternative can typically only include compliance monitoring. In general, the alternative is applicable when there is no current or potential threat to human health and the environment or when CERCLA exclusions preclude taking an action. Under No Action Alternatives, no funds are expended for control or remediation of the contaminated media. Funds are required for the statutory Five-Year Reviews (FYRs) of the Site for site visits, minimal compliance sampling and analyses of select contaminated media, review of regulatory changes, and report preparation.

The Pit Lake would remain in its present condition. Minimal periodic sampling and analysis of COCs in surface water of the Pit Lake would be used to track contaminant concentrations over the course of a 30-year monitoring period. This information will facilitate evaluation of the conditions within the CMZ for the FYR.

9.1.2 Pit Lake Alternative 2: Drain Lake, Add Amendments to Pit Floor, and Backfill Pit

Estimated Capital Costs: $17,636,097
Estimated Annual O&M Costs: $142,394
Estimated Present Worth Costs: $17,778,500
Estimated Time to Achieve RAOs/Cleanup Levels: ~2 yrs

This alternative consists of: treating approximately 73 Mgal of lake water and other inflows through a temporary onsite treatment plant that will discharge clean water to the North Tributary; amend the pit floor with lime and other reactants to reduce acid generation; backfilling the pit by using on-site and off-site borrow sources; recontouring to minimize groundwater inflow and surface water runoff controls; and, monitor seeps and North Tributary.

The treatment plant would likely be built in the former staging area as shown in **Figure 10** and the outfall discharge would be located in the North Tributary downstream of the Beaver Pond. As the pit floor becomes exposed, oxidization of pyritic materials will need to be prevented or minimized to prevent acid generation. This would be accomplished by adding various amendments to kill bacteria that promote acid generation and coat the material with other reactants and/or lime application.

Management and treatment of water entering the pit during backfill operations is required. Backfill will be accomplished using clean materials from on-site and off-site soil borrow areas. The backfilling will be completed to re-contour the new "hill" with surface water runoff controls. It is estimated that approximately 400,000 cy of backfill will be needed.

This alternative would meet the RAO for the Pit Lake but would not address the RAOs for the capped waste rock or groundwater.

9.1.3 Pit Lake Alternative 3: Drain Pit Lake, Cap Pit Floor, Partial Backfill, Create Wetland

Estimated Capital Costs: $14,394,139
Estimated Annual O&M Costs: $155,863
Estimated Present Worth Costs: $14,550,000
Estimated Time to Achieve RAOs/Cleanup Levels: ~2 yrs

This alternative consists of the following components: treat approximately 73 Mgal of lake water and other inflows through a temporary onsite treatment plant that will discharge clean water to the North Tributary; amend the pit floor with lime and other reactants to reduce acid generation and cover with impermeable cap; reduce the depth and size of pit by partially backfilling with material from on-site and off-site borrow areas, lower spillway, and re-contour pit; and, construct a wetland system to treat groundwater and surface water inflows (**Figure 11**).

The temporary treatment plant would be the same as described for Pit Lake #2. The exposed pit floor and walls would be treated with reactants to reduce acid generation prior to placement of an impermeable cap over the floor. Then material from borrow areas will be used to re-contour the pit and lower the spillway to allow clean water to discharge to the North Tributary. The shallower pit will be designed as a passive wetland to sequester metals from runoff and groundwater input.

This alternative would meet the RAO for the Pit Lake. It would aid in addressing the RAO for groundwater but would not address the RAO for the capped waste rock.

9.1.4 Pit Lake Alternative 4: Amendments to Pit Lake and Cap Pit Floor

Estimated Capital Costs: $9,224,251
Estimated Annual O&M Costs: $91,476
Estimated Present Worth Costs: $9,315,700
Estimated Time to Achieve RAOs/Cleanup Levels: ~2 yrs

This alternative consists of the following components: amend the Pit Lake with alkalinity and organic carbon to increase the pH and reduce metals concentrations; cover the pit floor with an impermeable cap to seal off from groundwater discharging into the Pit Lake and seal off the Pit Lake water from fractures leading to the seeps near the North Tributary; and, monitor lake water, seeps, and North Tributary (**Figure 12**).

Lime-based amendments such as sodium hydroxide and substantial amounts of organic carbon from cost-effective sources such as wood chips, molasses, or liquid manure would be mixed into the Pit Lake based on accurate water volumes and titration techniques. Large carbon “tea bags” would be used to help prevent settling to the bottom. The pit floor would be encapsulated using an impermeable material such as AquaBlok® or a sodium bentonite/soil mixture.

This alternative would meet the RAO for the Pit Lake but would not address the RAOs for the capped waste rock or groundwater.

9.2 Description of the Waste Rock (CMZ-2) Remedy Alternatives

The alternatives for the capped waste rock (CMZ-2) were developed to address the acid production from the waste rock in order to reduce or eliminate its impact on the Pit Lake water and groundwater within the waste rock area. None of the individual alternatives for the waste rock will meet all of the proposed OU1 RAOs. A combination of the best individual alternatives will need to be designed to meet all of the proposed RAOs. The five remedial alternatives developed for the waste rock are described in the following sections.

9.2.1 Waste Rock Alternative 1: No Action

Estimated Capital Costs: $0
Estimated Annual O&M Costs: $91,084
Estimated Present Worth Costs: $91,000
Estimated Time to Achieve RAOs/Cleanup Levels: N/A

This remedy is analogous to the No Action Alternative CMZ-1. Minimal periodic sampling and analysis of COCs in groundwater would be used to track contaminant concentrations over the course of a 30-year monitoring period.

9.2.2 Waste Rock Alternative 2: Excavation of Capped Waste Rock, and On-Site Disposal and Encapsulation, Backfill, and Cap Excavation

Estimated Capital Costs: $14,258,471
Estimated Annual O&M Costs: $325,857
Estimated Present Worth Costs: $14,584,300
Estimated Time to Achieve RAOs/Cleanup Levels: ~1.5 yrs

Waste Rock Alternative 2 consists of the following components: the excavation of approximately 250,000 cy of capped waste rock and on-site encapsulation; backfilling the excavated area with clean materials; capping the backfilled excavation; and, monitoring the Pit Lake water, seeps, and North Tributary (**Figure 13**).

This alternative would remove, through excavation, the 250,000 cy of capped waste rock. The waste rock would be transported to a location on-site and encapsulated. The excavated waste rock would be encapsulated in a geomembrane liner on top and bottom and finished with a clay cap. The encapsulation will be designed to prevent infiltration of water into the waste rock or seepage from the waste rock. A sheet pile wall may be required along the edges of the Pit Lake during excavation activities to prevent the excavation from filling with Pit Lake water. The excavated area would be backfilled with clean material brought in from off-site. The backfilled excavation would be revegetated and contoured to control stormwater runoff.

This alternative would address the capped waste rock and its associated RAO. It would also indirectly aid in addressing the RAOs for the Pit Lake and groundwater by removing the major source of acid generation in OU1.

9.2.3 Waste Rock Alternative 3: Amendments to Waste Rock, Enhancement of Existing Caps

Estimated Capital Costs: $4,400,646
Estimated Annual O&M Costs: $79,079
Estimated Present Worth Costs: $4,479,700
Estimated Time to Achieve RAOs/Cleanup Levels: ~2 yrs

Alternative 3 for the waste rock area consists of the following components: the capped waste rock would be amended with reactants (e.g., sodium lauryl sulfate and milk) to neutralize acid generation; an expansion and/or enhancement of the existing cap; and monitoring the Pit Lake water, seeps, and North Tributary **(Figures 14 to 17**).

Amendments such as sodium lauryl surface buffered with sodium bicarbonate would be added to the unsaturated and transition zones of the waste rock. These amendments were tested during the FS through a treatability study. The amendments to the unsaturated zone would be applied through a series of shallow injection wells. Amendments such as milk buffered with sodium bicarbonate would be added to the saturated zone of the waste rock to stop acid generation. The amendments would be added to the saturated waste rock through a series of injection wells that extend into the underlying bedrock. The existing cap would be expanded and/or enhanced to minimize rain and storm water infiltration. In addition, much of the area is compromised by shrub and tree growth. Removal would further minimize infiltration.

This alternative would address the RAO for the waste rock area and aid in addressing the RAOs for the Pit Lake and groundwater by reducing or stopping acid generation within the waste rock area.

9.3 Description of the OU1 Groundwater (CMZ-3) Remedy Alternatives

The alternatives for OU1 groundwater were developed to reduce or eliminate contaminated groundwater from impacting the waters of the Pit Lake and the North Tributary. No individual alternative for OU1 groundwater will meet all of the proposed RAOs. A combination of the best individual alternatives designed to meet all of the proposed RAOs is presented in Section 8.0. The four remedial alternatives developed for the OU1 Groundwater are:

9.3.1 OU1 Groundwater Alternative 1: No Action

Estimated Capital Costs: $0
Estimated Annual O&M Costs: $122,206
Estimated Present Worth Costs: $122,200
Estimated Construction Timeframe: N/A
Estimated Time to Achieve RAOs/Cleanup Levels: N/A

The OU1 Groundwater No Action Alternative is equivalent to the Pit Lake and Waste Rock, No Action alternatives. Minimal periodic sampling and analysis of COCs in groundwater would be used to track contaminant concentrations over the course of a 30- year monitoring period.

9.3.2 OU1 Groundwater Alternative 2A: Groundwater Diversion and Dewatering of the Capped Waste Rock – Barrier Wall and Grout Curtain

Estimated Capital Costs: $7,432,326
Estimated Annual O&M Costs: $74,495
Estimated Present Worth Costs: $7,506,800
Estimated Time to Achieve RAOs/Cleanup Levels: NA

Alternative 2A consists of the following components: installation of a barrier wall and grout curtain in the upper end of the capped waste rock area to divert unimpacted groundwater from oxidizing the buried waste; dewater the capped waste rock area by pumping groundwater into the Pit Lake; installing open limestone channels at the pit spillway and in channels where stormwater discharges into the Pit Lake; and monitor the Pit Lake water, seeps, and North Tributary.

A barrier wall approximately 600 ft long and 70 ft deep would be installed on the upper slope of the southeast cap area as shown on **Figure 18**. The barrier wall would be constructed by excavating a long, deep, and approximately 3-ft wide trench from ground surface to total depth (top of bedrock). It would be constructed by removing the existing native soils from the trench and backfilling the trench with a low permeability material. The grout curtain would extend from the top of bedrock down to a total depth of 160 feet bls. It would consist of the installation of two grout lines offset 10 ft from the proposed centerline of the barrier wall. The grout line on the downstream (to groundwater flow) side of the barrier wall would be completed first, followed by the upstream line, and finally verification holes performed between the lines and water pressure tested to confirm the design intent of the drilling and grouting has been met.

Individual grout lines are performed using split spacing of holes. For example, Primary borings are performed at a given spacing. Upon completion of the Primary borings in a given area, Secondary borings drilled halfway between the Primaries are performed. The split spacing process continues until the collective body of data indicates that the design intent has been met.

As a possible finishing step, the groundwater within the waste rock area could be extracted using a series of extraction wells. The groundwater would be pumped into the Pit Lake for in-situ treatment as part of Pit Lake alternatives 2 and 3.

Although not addressing groundwater directly, this alternative also recommends the installation of passive open limestone channels at the Pit Lake spillway and at areas where stormwater runoff enters the Pit Lake. These would be considered as a passive ex-situ treatment of water discharging from the Pit Lake at times of full pool. In addition, channels where stormwater discharges into the Pit Lake would be lined with limestone to help add alkalinity to the Pit Lake to aid in raising the pH within its waters.

This barrier wall and grout curtain would divert clean groundwater away from the waste rock area. This alternative would reduce the flow of groundwater into the waste rock area from the south-southwest which would aid in addressing the RAO for groundwater. It would not address groundwater already within the waste rock area or water discharging from the Pit Lake into fractures which feed the seeps. This alternative would not directly address the RAOs for the Pit Lake or the waste rock; however, it would prevent or minimize contamination of additional groundwater from upgradient sources.

933 OU1 Groundwater Alternative 2B: Groundwater Diversion and Dewatering of Capped Waste Rock – Hydraulic Barrier

Estimated Capital Costs: $1,995,286
Estimated Annual O&M Costs: $1,525,832
Estimated Present Worth Costs: $3,521,100
Estimated Time to Achieve RAOs/Cleanup Levels: NA

This alternative consists of the following components: installing a series of groundwater extraction wells in the upper end of the capped waste rock area to create a hydraulic barrier and reducing or preventing the flow of groundwater through the buried waste; dewater the capped waste rock area by pumping groundwater into the Pit Lake; installing open limestone channels at the pit spillway and in channels where stormwater discharges into the Pit Lake; and monitor lake water, seeps, and the North Tributary.
A hydraulic barrier approximately 600 ft long would be created on the upper slope of the southeast cap area as shown on **Figure 19**. The hydraulic barrier would be constructed by installing a series of groundwater extraction wells drilled into the underlying bedrock. Eight 6-inch wells would be installed to a total depth of 160 feet bls at 75-foot centers along the line depicted on **Figure 19**. Groundwater would be extracted from these wells to drawdown groundwater on the upper slope of the capped waste rock thus preventing or

greatly reducing groundwater flow through the waste rock. Extracted groundwater would be pumped into the Pit Lake provided the water quality of the groundwater would not negatively impact the Pit Lake water. An alternative would be to pump the groundwater into an infiltration pond or ponds. If extracted groundwater is found to be impacted, it will need treatment prior to discharge to the Pit Lake or infiltration ponds.

As a possible finishing step, the groundwater within the waste rock area could be extracted using a series of extraction wells. The groundwater would be pumped into the Pit Lake for in-situ treatment as part of Pit Lake alternatives 2 and 3.

As described for Alternative 2A, this remedy would also install open limestone channels at the Pit Lake spillway and stormwater entry points to the Pit Lake.

This alternative would reduce the flow of groundwater into the waste rock area from the south-southwest which would aid in addressing the RAO for groundwater. It would not address groundwater discharging from fractures which feed the seeps. This alternative would not directly address the RAOs for the Pit Lake or the waste rock; however, it would prevent or minimize contamination of additional groundwater from upgradient sources.

9.3.4 OU1 Groundwater Alternative 3: In-Situ Treatment of Groundwater

Estimated Capital Costs: $1,467,917
Estimated Annual O&M Costs: $5,253,119
Estimated Present Worth Costs: $6,721,000
Estimated Time to Achieve RAOs/Cleanup Levels: ~2 yrs

Alternative 3 for the OU1 Groundwater consists of installing a series of injection wells into the saturated capped waste rock area to add reactants and/or alkalinity to neutralize groundwater from oxidizing the buried waste, and monitoring (Pit Lake water, seeps, and North Tributary).

A series of injection wells will be installed to add alkalinity-related amendments to the groundwater within the waste rock and major fracture zones near the lake to reduce acidity as shown on **Figure 20**. The wells would be installed into the regolith and bedrock at various depths. Final amendments and quantities, along with the number and spacing of injection wells would be developed at the design stage. This alternative may require multiple injections to address the RAO for groundwater.

This alternative would address the RAO for groundwater. It would not directly address the RAOs for the waste rock area or the Pit Lake.

9.4 Institutional Controls

Institutional controls (ICs) will be required as part of the selected remedy. ICs are non-engineering measures which usually include legal, administrative, or governmental controls to affect human activities in such a way so as to prevent or reduce exposure to contamination. The purpose of the ICs is to impose on the subject property "use" restrictions for the purpose of implementing, facilitating and monitoring a remedial action to reduce exposure, thereby protecting human health and the environment. ICs will include notifying the public on restrictions on the use of shallow groundwater in the Site vicinity using public notices, advisories, and signage to designate the presence of contaminated groundwater. This passive remedy may provide a visible and practical reminder for the local public to maintain awareness of the Site and to minimize exposure for a negligible cost. These controls have no effect on aquatic life in the North Tributary. Currently the Site is fenced with no trespassing warning signs.

9.5 Distinguishing Features of Each Alternative

The following chart summarizes the advantages and disadvantages of each of the alternatives.

Alternative: No Action for all Alternatives Pit Lake 1, Waste Rock 1, OU1 Groundwater 1	
Criteria	**Analysis**
Advantages	• Low cost, no site disruption
Disadvantages	• Site would remain in current condition, no additional protection of human health and the environment. • The potential for ingestion or direct contact with contaminated media would remain. No improvement to the North Tributary expected.
Alternative: Pit Lake #2 Drain Lake, Amendments to Pit Floor, Backfill Pit	
Advantages	• The removal of the Pit Lake water may reduce or eliminate seepage flow through fractures to the North Tributary. • Water treatment is a common technology at mine sites.
Disadvantages	• Draining lake may not control seepage to the North Tributary due to contaminated groundwater beneath the pit and through the existing waste rock. It also would not prevent contamination of clean fill via groundwater flowing through the capped waste rock into the pit area. • Surface water treatment would require power and would be expensive. • High capital cost and O&M for questionable reduction of risk to the North Tributary. High capital risk if after backfilling the pit it is determined to have a poor outcome. Few options would remain should this alternative fail.
Alternative: Pit Lake #3 Drain Pit Lake, Cap Pit Floor, Partial Backfill, Create Wetland	
Advantages	• The removal of the Pit Lake water may reduce seepage flow through fractures to the North Tributary; • Water treatment is a common technology at mine sites; • Capping the pit floor with AquaBlok® or similar material and partially backfilling with clean material will reduce groundwater inflow; • A constructed anaerobic wetland would aid in removal of metals and raise the pH of any waters flowing over the spillway thus reducing the risk to the North Tributary; • Engineered wetlands are relatively common technologies at mine sites and technical resources to implement are well known.
Disadvantages	• Draining lake may not control seepage to the North Tributary due to contaminated groundwater beneath the pit floor and though the existing waste rock; • Surface water treatment would require power and would be expensive; • Anaerobic wetlands would likely require treatability studies of contaminated groundwater inflow volumes and quality to determine wetland size;

	• Wetlands have high capital cost and O&M for minimal reduction of risk to the North Tributary; • Would require detailed monitoring of wetland system performance. A constructed wetland would also require an on-going source of water moving through the system. May also require periodic reconstruction.
Alternative: Pit Lake #4 Amendments to Pit Lake and Cap Pit Floor	
Advantages	• Addition of amendments to the Pit Lake would likely raise pH to above 6 and reduce metals concentrations, thereby reducing threat to the North Tributary from discharge of contaminated water over the pit spillway; • Capping the pit floor with AquaBlok® or similar material and partially backfilling with clean material will reduce groundwater inflow; • The technical capability and cost assumptions to deliver various amendments to the Pit Lake have been demonstrated; • Low long-term O&M costs.
Disadvantages	• Pit Lake may require more than one amendment event, thus long-term monitoring and higher O&M costs are expected; • Groundwater diversion may not be able to divert significant groundwater volumes away from the waste rock area (e.g., if grout curtain cannot be adequately sized); • If fractured rock is extensive, this may limit level of effectiveness.
Alternative: Waste Rock #2 Excavation of Capped Waste Rock, On-Site Disposal and Encapsulation, Backfill Excavation, and Cap	
Advantages	• Removes the acid generating source material (waste rock) from impacting the Pit Lake and groundwater; • Excavation of waste rock is a common, easily implementable technology; • Relatively low long-term O&M costs.
Disadvantages	• Will require adequate space for on-site disposal area; • Will require long-term institutional controls to maintain integrity of encapsulated waste rock; • Encapsulated waste rock will require long-term O&M to maintain its integrity.
Alternative: Waste Rock #3 Amendments to Waste Rock and Enhancement of Existing Cap	
Advantages	• Addition of amendments to the capped waste rock should reduce or eliminate acid production; • Enhancement of the existing cap should reduce or eliminate surface water infiltration into the waste rock.
Disadvantages	• Amendments added to the waste rock is an uncommon technology at other mine sites; • May require pilot testing to ensure technology will be effective on-site; • Number and sizing of waste rock treatments is unknown (e.g., amendment quantities and application rates); may require some O&M costs; • Distribution of amendments to waste rock above the saturated zone would be difficult to control.
Alternative: OU1 Groundwater #2A Groundwater Diversion and Dewatering of Capped Waste Rock – Barrier Wall and Grout Curtain	
Advantages	• Groundwater diversion by installation of a barrier wall and possible pressure grouting of fracture zones would reduce the infiltration of groundwater through the waste rock thereby reducing contaminated groundwater inflow into the pit; • Technical resources are available to design and implement grout curtain or similar technology;

	• Dewatering of the capped waste rock would further reduce groundwater discharge into the Pit Lake and possibly into the North Tributary through existing seeps; • Low long-term O&M costs.
Disadvantages	• Groundwater diversion may not be able to divert significant groundwater volumes away from the waste rock area (e.g., if grout curtain cannot be adequately sized); • Recharge of groundwater within the capped waste rock may occur if groundwater diversion is unsuccessful; • If fractured rock is extensive, this may limit level of effectiveness.
Alternative: OU1 Groundwater #2B Groundwater Diversion and Dewatering of Capped Waste Rock – Hydraulic Barrier	
Advantages	• Groundwater diversion by installation of a hydraulic barrier would reduce the infiltration of groundwater through the waste rock thereby reducing contaminated groundwater inflow into the pit; • Technical resources are available to design and implement a hydraulic barrier; • Dewatering of the capped waste rock would further reduce groundwater discharge into the Pit Lake and possibly into the North Tributary through existing seeps.
Disadvantages	• Groundwater extraction as part of the hydraulic barrier may not be able to divert significant groundwater volumes away from the waste rock area; • Recharge of groundwater within the capped waste rock may occur if groundwater diversion is unsuccessful; • Groundwater extracted at the barrier may require treatment prior to discharge; • Potentially impacted groundwater from Waste Area C may migrate to the extraction wells due to long-term pumping required to maintain the hydraulic barrier; • High Long-term O&M costs.
Alternative: OU1 Groundwater #3 Add Alkalinity to Groundwater	
Advantages	• The addition of alkalinity to groundwater should substantially reduce acid generation from the waste rock; • The effectiveness of adding neutralizing compound to acidic media is well documented; • The technical capability to deliver amendments to groundwater has been demonstrated; • Low long-term O&M costs.
Disadvantages	• The number and spacing of groundwater injection wells is unknown; • Adding alkalinity to the groundwater would require an alkalinity injection system for repeated amendment events, resulting in relatively high capital costs and O&M expenditures.

10.0 COMPARATIVE ANAYSIS OF ALTERNATIVES

The NCP establishes a framework of nine criteria for evaluating remedial alternatives. Each alternative must meet the threshold criteria of overall protection of HH&E and compliance with ARARs in order to be considered for further evaluation against the five balancing criteria. The FS used a comparative analysis to assess the relative performance of each alternative in relation to the nine criteria. The purpose of this analysis was to identify the advantages and disadvantages of each alternative relative to the other alternatives. Analysis of alternatives was conducted separately for each of the three CMZs although consideration was given to the other CMZs.

10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through exposure pathways are eliminated, reduced or controlled, through treatment, engineering controls and/or ICs.

All of the Pit Lake alternatives, with the exception of Pit Lake #1, No Action, is not protective of human health and the environment. All three active alternatives Pit Lake #2 (Drain Pit Lake, Treat, Discharge to SW; Add Amendments/Cap Pit Floor, Backfill Pit), Pit Lake #3 (Drain Pit Lake, Treat, Discharge to SW; Amendments/Cap Pit Floor, Partial Backfill, Create Wetland), and Pit Lake #4 (Treat/Neutralize Pit Lake in place, Cap Pit Floor) are protective of human health and the environment.

All of the Waste Rock alternatives, with the exception of Waste Rock #1, No Action, is not protective of human health and the environment. Alternatives Waste Rock #2 (Excavate and On-Site Encapsulation of Waste Rock, Backfill Excavation and Cap) and Waste Rock #3 (Amendments to Waste Rock, Enhance Existing Cap) are protective of human health and the environment.

All of the OU1 Groundwater alternatives, with the exception of Groundwater #1, No Action, is not protective of human health and the environment. Alternatives Groundwater #2A (Groundwater Diversion and Dewatering of Capped Waste Rock, Monitoring – Barrier Wall and Grout Curtain) and Groundwater #3 (Groundwater In-Situ Neutralization) are protective of human health and the environment.

10.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that RAs at CERCLA sites attain legally applicable or relevant and appropriate federal and more stringent state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4). Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements, are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

ARARs do not include occupational safety or worker protection requirements. Compliance with the Occupational Safety and Health Administration (OSHA) standards is separately required by 40 CFR §300.150.

Under CERCLA Section 121(e)(1), federal, state, or local permits are not required for the portion of any removal or remedial action conducted entirely 'on-site' as defined in 40 CFR §300.5. See also 40 CFR §300.400(e)(1) & (2). Also, CERCLA response actions must only comply with the "substantive requirements," not the administrative requirements of a regulation or law. Administrative requirements include permit applications, reporting, record keeping, inspections, and consultation with administrative bodies. Although consultation with state and federal agencies responsible for issuing permits is not required, it is often recommended for determining compliance with certain requirements such as those typically identified as location-specific ARARs. See EPA, Office of Solid Waste and Emergency Response (OSWER) Directives No. 9234.1-01 and 9234.1-02, CERCLA Compliance with Other Laws Manual: Parts 1 and Part II.

In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release that may be useful in developing Superfund remedies. See 40 CFR §300.400(g)(3). The "to-be-considered" (TBC) category consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may assist in determining, for example health-based levels for a particular contaminant for which there are no ARARs or the appropriate method for conducting an action. TBCs are not considered legally enforceable and, therefore, are not considered to be applicable for a site but typically are evaluated along with Chemical-specific ARARs as part of the risk assessment to determine protective cleanup levels. See EPA, OSWER Directives No. 9234.1-01 and 9234.1-02, CERCLA Compliance with Other Laws Manual: Parts 1 and Part II, Section 1.4.

For purposes of ease of identification, the EPA has created three categories of ARARs: Chemical-, Location- and Action-Specific. Under 40 CFR §300.400(g)(5), the lead and support agencies shall identify their specific ARARs for a particular site and notify each other in a timely manner as described in 40 CFR §300.515(d).

Chemical-Specific ARARs/TBC Guidance

Chemical-specific ARARs are usually health or risk-based numerical values limiting the amount or concentration of a chemical that may be found in, or discharged to, the environment. The chemical-specific ARARs include (e.g. SDWA or mor stringent state Primary drinking water or groundwater quality standards for groundwaters identified as having a beneficial use as a drinking water source. Chemical-Specific ARARs for the Site are provided in **Table 14**.

Location-Specific ARARs/TBC Guidance

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, streams). Location-Specific ARARs for the Site are provided in **Table 15**.

Action-Specific ARARs/TBC Guidance

Action-specific ARARs are usually technology-based or activity-based requirements or limitations that control actions taken at hazardous waste sites. Action-specific requirements often include performance, design and controls, or restrictions on particular kinds of activities related to management of hazardous substances. Action-specific ARARs are triggered by the types of remedial activities and types of wastes that are generated, stored, treated, disposed, emitted, discharged, or otherwise managed. Potential action-specific ARARs include federal and state requirements for general construction management requirements (preventing fugitive dust and control of stormwater runoff from land disturbing activities), underground injection control (UIC well regulations for injecting reagents to remediate groundwater), air emission limitations for treating VOC contaminated groundwater, and RCRA waste characterization, treatment, storage and disposal requirements for soils and secondary wastes that are generated by remedial activities. The Action-Specific ARARs for the Site are provided in **Table 16**.

Compliance with Identified ARARs

In accordance with 40 CFR §300.400(g), EPA and SCDHEC have identified the potential ARARs and TBCs for the evaluated alternatives.

In general, chemical-specific ARARs can be met most effectively by reducing contaminant mass from a site (by treatment or by removal). In particular, the ability of a remedial alternative to meet the target cleanup level(s) for the COCs is important. Alternatives Pit Lake #2, Pit Lake #3, and Pit Lake #4 are all likely to have success at reducing the mass and concentration of contaminants in the Pit Lake. The two active waste rock alternatives (Waste Rock #2 and Waste Rock #3) both are projected to be aggressive treatment alternatives and are expected to have the most comprehensive success at reducing the mass and concentration of contaminants, within a relatively short timeframe. OU1 Groundwater #3 is projected to be the most aggressive treatment alternative and expected to have the most comprehensive success at reducing the mass and concentration of contaminants and should do so in a short timeframe.
OU1 Groundwater #2A and OU1 Groundwater #2B followed closely.

All alternatives evaluated trigger compliance with Action-Specific ARAR requirements for runoff and air emissions controls during land disturbing activities; characterization, storage, treatment and disposal of wastes; and installation and closure of monitoring wells. Waste Rock Alt #2 (excavation, on-site disposal and capping) requires compliance with additional RCRA ARARs such as LDRs and landfill cap closure design and post-closure care requirements. Alternatives Waste Rock #3, GW#2A and GW#3 involving subsurface injections require compliance with SDWA underground injection control (UIC) requirements. Alternatives such as GW#2B (hydraulic barrier) or activities involving dewatering of waste rock dump require characterization of extracted groundwater and, potentially, treatment prior to discharge.

10.3 Long-Term Effectiveness and Permanence

Long-Term Effectiveness and Permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

The Long-Term Effectiveness and Permanence criterion has particular importance for the Pit Lake remediation due to the RAO of preventing continued impact to OU3, specifically the North Tributary. Thus, aggressive and comprehensive technologies can be expected to provide better assurance of long-term effectiveness and permanence. The likelihood of the three active alternatives to meet performance specifications in the near term is high.

Alternatives that physically remove contaminants from the Site media and address the long-term impact of the waste rock provide the most protection for the longest period, which Waste Rock #2 remedial alternative offers. The likelihood of this alternative to meet performance specifications in the near term is high. Waste Rock #3 is also an aggressive and comprehensive technology that can be expected to provide long-tern effectiveness and permanence.

OU1 Groundwater #2A, OU1 Groundwater #2B, and OU1 Groundwater #3 remedial alternatives all are aggressive and comprehensive technologies that can be expected to provide better assurance of long-term effectiveness and permanence.

10.4 Reduce Toxicity, Mobility or Volume through Treatment

Reduction of toxicity, mobility or volume (T/M/V) through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

The No Action alternative for the three CMZs does not include treatment.

Alternatives Pit Lake #3 and Pit Lake #4 offer the best reduction of the mass,volume, and concentration of COCs by directly addressing the Pit Lake and indirectly addressing groundwater in OU1 by removal or in-situ treatment of the lake water. Pit Lake #2 only addresses the Pit Lake water (by removal and treatment). Alternative Waste Rock #3 offers the best reduction of the mass, volume, and concentration of COCs for the Waste Rock CMZ by in-situ treatment. Alternative Groundwater #3 offers the best reduction of the mass, volume, and concentration of COCs by directly addressing groundwater by in-situ treatment.

10.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

For the active Pit Lake remedies Pit Lake #4 should have the smallest impact on the community and construction workers and has a relatively short implementation timeframe (one year). The remaining active alternatives should also have minimal impacts but have longer projected timeframes. Waste Rock #3 was ranked highest of the two active waste rock alternatives because it should have the smallest impact on the community and construction workers, has minimal environmental impacts and has a relatively short implementation timeframe. All three active OU1 groundwater remedies ranked equally high for short-term effectiveness. Groundwater #2A, and Groundwater #2B do not reduce, in the short-term, the impact of wildlife drinking from the pit water (RAO 1).

10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All of the active alternatives are easily implemented. All materials and services needed for implementation are readily and commercially available. The site logistics of implementation increase in difficulty as more treatment components are added in each alternative. Pit Lake #2, Pit Lake #3 and Waste Rock #2 alternatives will involve extensive earthmoving efforts.

10.7 Cost

Cost estimates, including capital costs and long-term operating costs, were prepared for each alternative, and are summarized in **Table 17**. There are no capital costs associated with the No Action Alternatives. Costs for the implementation of Five-Year-Reviews, groundwater monitoring and institutional controls are included as the Site-Wide Costs. These O&M costs were estimated separately as they apply to all remedy alternatives until cleanup goals are met at the Site.

10.8 State Acceptance

The State of South Carolina has been involved actively in the process of determining and evaluating the Barite Hill/Nevada Goldfields OU1 cleanup alternatives. The state has expressed support of a combination phased approach in implementation of Pit Lake #4, Waste Rock #3 and OU1 Groundwater #2A Alternatives. The SCDHEC concurrence letter is included as Appendix B.

10.9 Community Acceptance

During the public comment period, the community did not express its support or opposition to the remedial strategy selected which includes a combination of Pit Lake #4, Waste Rock #3 and OU1 Groundwater #2A Alternatives.

11.0 PRINCIPAL THREAT WASTE (PTW)

The NCP establishes an expectation that the EPA will address the principal threats posed by a site through treatment wherever practicable (NCP §300.430(a)(1)(iii)(A)). PTW is defined on a site-specific basis for source material that acts as a reservoir for migration of contaminants or acts as a source for direct exposure. In general, the priority for treatment for PTW is placed on source materials considered to be liquid, highly toxic and/or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

Where the EPA determines that it is not practical to use treatment to address PTW, the material may be transported off-site for disposal, consistent with Off-Site Rule, 40 CFR 300.440, or contained on-site provided it is protective of HH&E and complies with all ARARs. Engineering controls, such as containment and consolidation in a cell that has a secure liner and final cover system, may be used for such wastes that pose a relatively low long-term threat or where treatment is deemed impracticable.

The capped waste rock at Barite Hill OU1 is considered to be a principal threat waste at this Site. Groundwater and surface water impacts indicate that contaminants leaching from the waste rock are present and highly mobile.

12.0 SELECTED REMEDY

12.1 Summary of the Rationale for the Selected Remedy

The Selected Remedy for the Barite Hill OU1 site is a combination of the following alternatives:

- Pit Lake Alternative #4 – Amendments to the Pit Lake, Cap the Pit Floor
- Waste Rock Alternative #3 – Amendments to the Waste Rock
- OU1 Groundwater Alternative #2A – Groundwater Diversion – Barrier Wall and Grout Curtain

These alternatives were chosen based on the comparative analysis of all of the alternatives. The Selected Remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to balancing and modifying criteria. EPA and SCDHEC determined that the Preferred Alternative presented in the Proposed Plan best satisfies the nine criteria of the NCP as compared to the other alternatives.

Based on the information available at this time, EPA and SCDHEC believe that the Selected Remedy combination satisfies the following statutory requirements of CERCLA Section 121(b) and Section 121(d): 1) protects human health and the environment; 2) complies with ARARs; 3) is cost effective; 4) utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfies the preference for treatment as a principal element.

A phased response action is recommended for the Site. The use of a phased approach would allow EPA to mitigate more immediate site-specific threats while concurrently collecting additional characterization data to determine the best method for attaining long term objectives.

12.2 Description of the Selected Remedy

12.2.1 Pit Lake

Alternative #4 is recommended to address CMZ-1, which is comprised of acidic and metals laden water in the Pit Lake and submerged acid-generating waste rock within the Pit Lake (**Figure 12**). The proposed amendments (hydrated lime slurry, organic materials and agricultural lime) that will be added to the lake are expected to raise the pH of the lake in both the short and long term resulting in the dissolved metals precipitating out of solution and depositing on the pit floor. The pit floor would subsequently be capped with an impermeable material (AquaBlok® and/or a sodium bentonite/clay soil mixture).

This cap is expected to seal off the submerged waste rock from the waters of the Pit Lake aiding in raising the pH and preventing groundwater from discharging into the Pit Lake. It will also reduce or prevent lake water from escaping through the lake bottom into the underlying regolith and fractured bedrock, thus reducing or eliminating the source of seeps to the North Tributary. This alternative is expected to be relatively easy to implement and should produce results in the Pit Lake within a short time frame (less than a year). The implementation of this remedy is not expected to negatively impact surrounding properties.

12.2.2 Waste Rock

Alternative #3 is recommended to address CMZ-2 (**Figures 14 through 17**). It will involve injecting either 1) sodium lauryl sulfate buffered with sodium bicarbonate or 2) milk buffered with sodium bicarbonate into the capped waste rock. The amendments will be injected across the 6.6-acre waste rock area through a series of both shallow and deeper wells, primarily targeting both the transition zone and groundwater saturated zones. Sodium lauryl sulfate was shown in a Tier 1 treatability study, conducted during the FS, to work better within the unsaturated zone of the waste rock area, but the beneficial effects in treating the unsaturated zone (at significant additional costs) seem marginal.

The treatability study showed that milk works more effectively within both the transition zone and the saturated zone. The treatability study demonstrated that these amendments were effective at suppressing acid generation within the waste rock. This will result in the reduction of acid generation. With the reduction of acid generation there would be a reduction in the concentration of metals within the groundwater migrating through the waste rock into the Pit Lake and/or the seeps along the North Tributary. This alternative should be relatively easy to implement, although additional laboratory treatability studies should be conducted during the Remedial Design to optimize the dosing and application approach for the amendments. The implementation of this remedy should have noimpact upon the surrounding properties.

12.2.3 OU1 Groundwater

Alternative #2A is recommended to address CMZ-3 (**Figure 18**). This alternative will consist of an approximate 600-foot long barrier wall installed to the top of bedrock (~70 ft bls) along the southern edge (hydraulically upgradient) of the capped waste rock. The grout curtain would extend from the top of bedrock down to a total depth of 160 feet bls. It would consist of the installation of two grout boring lines offset 10 ft from the proposed centerline of the barrier wall. The barrier wall and grout curtain are expected to prevent or significantly reduce the flow of groundwater into and through the buried waste rock, which in turn will eliminate or reduce the volume of acidic groundwater entering the Pit Lake. Although this alternative does not directly treat the groundwater, it is expected to prevent or significantly reduce contact with clean groundwater currently migrating into the waste rock. Thereby eliminating the migration of groundwaterthrough the waste rock that continues to generate on-going contaminated groundwater.

An option to dewater the waste rock after construction of the barrier wall and grout curtain would consist of a series of extraction wells installed within the waste rock area. Extracted groundwater would be pumped into the Pit Lake where it would be subjected to the recommended alternative for the Pit Lake. This would further reduce the amount of groundwater in contact with the waste rock that discharge via seeps near the North Tributary.

Although not addressing groundwater directly, this alternative also recommends the installation of passive open limestone channels (OLC) at the Pit Lake spillway and at areas where stormwater runoff enters the Pit Lake. These would be considered as a passive ex situ treatment of water discharging from the Pit Lake at times of full pool. Flow across the spillway would be diverted into a pipe and conveyed to an OLC which is a lined channel constructed of cobble or gravel-sized limestone rock. In addition, channels where stormwater discharges into the Pit Lake would be lined with limestone to help add alkalinity to the Pit Lake to aid in raising the pH within its waters.

This alternative is considered implementable but has some potential for challenges, especially with the grout curtain installation. Design investigation borings will be needed along the proposed barrier wall and grout curtain alignment, along with hydraulic testing to better characterize the bedrock fracture orientation and architecture. Hydraulic testing during implementation of the grout curtain will also be important to confirm design criteria and goals have been achieved. Experienced contractors in this specialty field will be necessary. Implementation is estimated to take less than one year. The impact upon groundwater will be gradual, depending upon the seepage velocity of groundwater within OU1. The implementation of this remedy is not expected to have an impact upon the surrounding properties.

12.2.4 Institutional Controls

ICs will be required as part of the selected remedy. ICs are non-engineering measures which usually include legal controls to affect human activities in such a way so as to prevent or reduce exposure to contamination. The purpose of the ICs is to impose on the subject property "use" restrictions for the purpose of implementing, facilitating and monitoring a remedial action to reduce exposure, thereby protecting human health and the environment.

ICs will include notification on the restrictions on the use of shallow groundwater in the Site vicinity using public notices, advisories, and signage to designate the presence of contaminated groundwater. This passive remedy may provide a visible and practical reminder for the local public to maintain awareness of the Site and to minimize exposure for a negligible cost. Currently the Site is fenced with no trespassing warning signs.

12.2.5 Cost Estimate for the Selected Remedy

The estimated total net present worth cost for the Selected Remedy is $21,302,200. The cost estimate for the Selected Remedy is included in **Table 17.** Detailed cost breakdown sheets of the components of each alternative are included in Appendix C. The cost estimate is based on the available information regarding the anticipated scope of the remedial action. Changes in the cost elements are likely to occur as a result of new information and data collected during the RD phase. Major changes may be documented in the form of a memorandum to the AR file, an Explanation of Significant Differences (ESD), or a ROD Amendment. The projected cost is based on an order-of-magnitude engineering cost estimate that is expected to be within +50 or -30 % of the actual project cost. Costs are based on the conservative estimate of a 30-year timeframe until all cleanup levels are met.

13.0 RECOMMENDED PHASING

A phased response action is recommended for the Site. The preferred alternatives that are proposed to address the Pit Lake, the capped waste rock, and groundwater contamination are anticipated to be implemented in a phased-approach. This approach involves addressing the contamination identified within a specific CMZ before implementing the remedial action of another CMZ. This phased-approach creates an adequate opportunity to evaluate the effectiveness of each remedy component and to determine the needs of the next phase.

The recommended phasing for the overall remedy is as follows:

Phase	Task Description	Action
I	Site preparation	Grub and fence the facility.
II	Install the Barrier Wall, Grout Curtain, and OLC	Install borings for the grout curtain. Inject grout for the bedrock grout curtain. Install the barrier wall. Install the OLC at the pit spillway and stormwater drainage channels.
III	Amendments to the Capped Waste Rock	Install both shallow and deeper injection wells within the capped waste rock. Inject milk and sodium bicarbonate into the waste rock area wells. Enhance the existing caps over the waste rock. If determined to be warranted, install extraction wells within the waste rock and dewater.
IV	Amendments to the Pit Lake, Cap Pit Floor	Add amendments to the Pit Lake. Allow for metals to settle out. Install cap over the pit floor.
VI	Monitoring and FYR	Evaluate remedial progress and make recommendations for both OU1 and OU3.

13.1 Estimated Outcomes of the Selected Remedy

The Selected Remedy will protect HH&E by eliminating, reducing, or controlling risks at the Site through physical and chemical treatment of waste from areas of access by receptors, monitoring of engineering controls, and implementation of the ICs. Future land use of the Site property is anticipated to be for recreational use. Implementation of the Selected Remedy and achievement of the interim cleanup levels will accomplish the interim RAOs for OU1 and possibly OU3. The final cleanup levels determined for this remedy are the same as those determined during the FS and are shown in **Table 13**.

14.0 STATUTORY DETERMINATION

Based on the information currently available, EPA believes the chosen Selected Remedy for each of the CMZs meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying Criteria. EPA expects the Selected Remedy will satisfy the following statutory requirements of CERCLA Section 121(b):

- Be protective of human health and the environment.
- Comply with ARARs;
- Be cost effective; and
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

14.1 Protection of Human Health and the Environment

Protection of HH&E will be achieved through the treatment of both the Pit Lake water and waste rock. The remedy would also reduce the flow of groundwater moving through the waste rock and discharging into the Pit Lake and the North Tributary.

14.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate federal and more stringent state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4). The Selected Remedy will comply with all ARARs presented in **Tables 16, 17 and 18**.

14.3 Cost Effectiveness

EPA has determined that the Selected Remedy is cost-effective, and that the overall protectiveness of the remedy is proportional to the overall cost. As specified in 40 CFR §300.430(f)(1)(ii)(D), the cost-effectiveness of the Selected Remedy was assessed by comparing the protectiveness of human-health and the environment in relation to three balancing criteria (i.e., long-term effectiveness and permanence; reduction in T/M/V; and short-term effectiveness) with the other alternatives considered.

The basis for EPA's determination of cost-effectiveness is summarized in Section 9 of the FS (Black & Veatch, 2018b). While more than one remedial alternative can be considered cost-effective, CERCLA does not mandate that the most cost-effective or least expensive remedy be selected. Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

14.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of HH&E and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of tradeoffs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element, bias against off-site treatment and disposal, and considering State and community acceptance. The capped waste rock at Barite Hill OU1 is considered to be principal threat waste at this Site. Information about site operations coupled with the documented groundwater and surface water impacts indicate that contaminants leaching from the waste rock are present and are highly mobile. The interim remedy includes treatment of the waste rock to reduce the mobility of contaminants.

14.5 Preference for Treatment as a Principal Element

The NCP at 40 CFR §300.430(a)(I)(iii)(A) establishes an expectation that treatment will be used to address PTW posed by a site wherever practicable. In general, the priority for treatment for PTW is placed on source materials considered to be liquid, highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

The capped waste rock at Barite Hill OU1 is considered to be principal threat waste at this Site. Information about site operations coupled with the documented groundwater and surface water impacts indicate that contaminants leaching from the waste rock are present and are highly mobile. The interim remedy includes treatment of the waste rock to reduce the mobility of contaminants

14.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review per CERCLA Section 121(c) will be conducted within five years after initiation of the RA to ensure that the Selected Remedy is, or will be, protective of human health and the environment. EPA will conduct a FYR until levels that allow for unlimited use and unrestricted exposures are achieved.

14.7 Documentation of Significant Changes

Pursuant to CERCLA 117(b) and NCP §300.430(f)(3)(ii), the ROD must document any significant changes made to the Preferred Alternative discussed in the Proposed Plan. The Proposed Plan, which was released for public comment February 7, 2020 identified a phased approach in implementation of Pit Lake #4, Waste Rock #3, and OU1 Groundwater #2A as the site-wide Preferred Remedy for the Barite Hill OU1 site. ICs to restrict land use and prevent disturbance of on-site engineering controls are included in the Selected Remedy. The ICs may include a restrictive covenant, property deed notice, and governmental controls such as local ordinances or zoning restrictions.

EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

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RESPONSIVENESS SUMMARY

1.0 Overview

This is a Responsiveness Summary, responding to comments that the public has made regarding the EPA's Proposed Plan for the cleanup of hazardous substance contamination at the Barite Hill/Nevada Goldfields OU1 Superfund Site. The comments responded to in this Responsiveness Summary were taken from the transcript of the public meeting for the Proposed Plan held on March 5, 2020 (Appendix A).

A Responsiveness Summary serves two functions: first, it provides the decision maker with information about the views of the public, government agencies, and potentially responsible parties regarding the proposed remedial action and other alternatives; and second, it documents the way in which public comments have been considered during the decision-making process and provide answers to significant comments.

Under the EPA policy, responsiveness summaries are divided into two parts. The first part is a summary of general stakeholder issues and concerns, and it will expressly acknowledge and respond to those issues and concerns raised by major stakeholders (e.g., community groups, support agencies, businesses, municipalities, potentially responsible parties). The second part is a comprehensive response to all specific comments. It is comprised mostly of specific legal and technical questions, and, if necessary, will elaborate with technical detail on answers covered in the first part of the responsiveness summary.

2.0 General Stakeholder Issues and Concerns

Comment No. 1: *The Associated Press released a report published widely and in the February 21, 2019 issue of the Greenwood, SC Index-Journal (page 7A) listing, "Mine sites with zero containment, active treatment or storage of contaminated water." The 5th highest ranked contaminated site, by "gallons per day discharge," is the "Barite Hill/ Goldfields" site in McCormick, SC, with an average daily discharge of 455,040 gallons of contaminated water per day. Is this an accurate report, and how and by whom was the daily release of contaminated water calculated or determined- in your office or at EPA headquarters? If it is, what will be the impact of this release on the environment and populace of McCormick County. If this is not an accurate report, has it been challenged or publicly repudiated by EPA at any organizational level? If so, when and in what media was this repudiation/denial published/issued? If not, why not?*

EPA Response: EPA Region 4 was not consulted prior to the publication of the article referenced. Following the publication of the article, we reviewed our records and do not know how the "gallons per day discharge" was calculated.

Comment No. 2: *EPA has scheduled and then subsequently canceled at least two public hearings on the former Barite Hills mining operation during the past one or two years, before scheduling the public hearing for March 5, 2020. Why have these hearings been canceled/delayed and what impact, if any, have these delays had on the environment of McCormick County, and the health and safety of its residents?*

EPA Response: The EPA has rescheduled the Proposed Plan meeting and we are unaware of any impacts these changes have had on the health and safety of the residents of McCormick County.

Comment No. 3: *What has been and what will be the extent of the contamination of groundwater sources - runoff and subterranean seepage into the water table - adjacent to the site or anywhere in McCormick County since the cessation of operations of the mine circa 1996, the reclamation of the site by Nevada Goldfields until 1999, and the application of mitigation and/or abatement measures by EPA or DHEC - past, present and future? Project future contamination of the environment both with and without the mitigation and abatement measures contained in the proposed plan/preferred alternative*.

EPA Response: Efforts to characterize the extent of contamination and select remedies for all five OUs at the Site is ongoing.

Comment No. 4: *What is the extent or designated/planned area of the local vicinity and the entire county for which well monitoring and testing are being done and will be done to determine the past and future contamination of the water table, if any?*

EPA Response: EPA completed a water use survey in 2011 and subsequently sampled private wells identified in the survey, in 2011 and 2012. The EPA did not detect any Site related contaminants in any of the private wells sampled.

Comment No. 5: *What has been and will be the frequency of monitoring and testing wells in the local vicinity/county to determine contamination of the water table? Where and under what circumstances will this monitoring, testing and analysis be carried out and when/how will the results be reported on a routine basis to the public?*

EPA Response: The EPA did not detect any Site related contaminants in any of the private wells sampled in 2011 and 2012. As part of the ongoing efforts to characterize contamination at the Site, EPA has installed and sampled groundwater monitoring wells at the Site. Forty-six wells have been sampled to date and will continue to be sampled periodically as we move forward with delineating Site related contamination.

Comment No. 6: *What has been and will be the frequency of monitoring and testing of groundwater runoff in the local vicinity/county to determine contamination of streams, farm ponds and lakes, including Thurmond/Clarks Hill Lake? Where and under what circumstances will this monitoring, testing and analysis be carried out and when/how will the results be reported on a routine basis to the public?*

EPA Response: As part of the ongoing efforts to characterize contamination at the Site, EPA will continue to collect samples onsite and from the Tributaries to Hawe Creek, and Hawe Creek. Sample results will be provided in Remedial Investigation / Feasibility Study (RI/FS) reports published for the Site. For OU1 these reports are included in the Administrative Record (AR) for the Site and are available for review at the Site Repository located at the McCormick County Public Library, 201 Railroad Ave., and online at https://www.epa.gov/superfund/barite-hill-nevada-goldfields.

Comment No. 7: *What has been and will be the frequency of monitoring and testing of farm animals and wildlife in the local vicinity/county to determine the extent, if any, of the contamination of such fauna through groundwater runoff or watering by well water? This would include the monitoring and testing of marine wildlife (e.g., fish), livestock, deer, wild hogs, small mammals, birds/fowl and predators. Where and under what circumstances will this monitoring, testing and analysis be carried out and when/how will the results be reported on a routine basis to the public?*

EPA Response: As part of the ongoing efforts to characterize contamination at the Site, EPA will continue to collect samples onsite and from the Tributaries to Hawe Creek, and Hawe Creek. Sample results will be provided in RI/FS reports for the Site. Ecological and Human Health Risk Assessments are included in the RI/FS reports. For OU1 these reports are available for review at the Site Repository located at the McCormick County Public Library, 201 Railroad Ave., and online at https://www.epa.gov/superfund/barite-hill-nevada-goldfields.

Comment No. 8: *What has been and will be the frequency of monitoring and testing of flora (forage and ornamental grasses, domestic and wild flowers, garden and field crops, trees and shrubs, etc.) in the local vicinity/county to determine the extent, if any, of the contamination of such plant species through groundwater runoff or watering/ irrigation by well, pond, stream or lake water? Where and under what circumstances will this monitoring, testing and analysis be carried out and when/how will the results be reported on a routine basis to the public?*

EPA Response: EPA continues to characterize contamination at the Site and complete Ecological and Human Health Risk Assessments.

Comment No. 9: *What has been and will be the frequency of monitoring and testing of soil samples in the local vicinity/county to determine the extent, if any, of the contamination of the soil through water runoff, watering or irrigation? Where and under what circumstances will this monitoring, testing and analysis be carried out and when/ how will the results be reported on a routine basis to the public?*

EPA Response: As part of the ongoing efforts to characterize contamination at the Site, EPA will continue to collect samples onsite. Some of the samples collected will be soil samples. Sample results will be provided in RI/FS reports published for the Site. For OU1 these reports are included in the AR for the Site and are available for review at the Site Repository located at the McCormick County Public Library, 201 Railroad Ave., and online at https://www.epa.gov/superfund/barite-hill-nevada-goldfields.

Comment No. 10: *What has been and will be the frequency of monitoring and testing of the human population in the local vicinity/county to determine the extent, if any, of the contamination of the blood, hair, tissue and organs of both adults and children who may have been exposed to contaminants present at the site, from contaminants that have been carried from the site by water runoff or seepage, or from consumption of contaminated fauna or flora which have not been successfully eliminated, controlled, mitigated or abated? Where and under what circumstances will this monitoring, testing and analysis be carried out and when/how will the results be reported on a routine basis to the public?*

EPA Response: At this time, EPA is not aware of any current or ongoing risks to human health from Site related contamination that would warrant the collection of the types of samples described. Human health and ecological risks have been evaluated for OU1 and a summary of those risks is provided in the Proposed Plan. The full Human Health Risk Assessment and Baseline Ecological Risk Assessment can be found in the RI/FS for OU1. In addition, the Agency for Toxic Substances and Disease Registry (ATSDR) completed a Public Health Assessment, dated July 15, 2011. These reports are included in the AR for the Site and are available for review at the Site Repository located at the McCormick County Public Library, 201 Railroad Ave., and online at https://www.epa.gov/superfund/barite-hill-nevada-goldfields.

Comment No. 11: *How and under what circumstances will local physicians in the county and other public and private medical and health facilities serving county residents be informed of real or possible conditions and diseases for which contamination from the site may be the cause or contributing factor, particularly by children and the elderly? How and under what circumstances that protect the legal rights of patients to privacy be reported on a routine basis to the public?*

EPA Response: Impacts to human health and ecological risks have been evaluated for OU1 and a summary of those risks is provided in the Proposed Plan. In addition, the ATSDR completed a Public Health Assessment, dated July 15, 2011. These reports are included in the AR for the Site and are available for review at the Site Repository located at the McCormick County Public Library, 201 Railroad Ave., and online at https://www.epa.gov/superfund/barite-hill-nevada-goldfields.

Comment No. 12: *What is the specific timetable/schedule for approving the proposed preferred alternative for OU1, soliciting bids for implementation contract(s), awarding contracts, and contract starts/completion(s)?*

EPA Response: EPA has selected the remedy presented during the Proposed Plan meeting held at the McCormick County Administrative Center on March 5th, 2020. The remedy for OU1 will be phased and a Remedial Design will be completed for each phase prior to moving forward with the Remedial Action. Although it's difficult to estimate, the EPA currently anticipates completing the first and second phases of the remedy for OU1 in approximately six years.

Comment No. 13: *What are the specific resources, if known, that will be required for contract implementation (human, physical, etc.)?*

EPA Response: It's unknown at this time what specific resources will be required to complete each phase of the remedy for OU1.

Comment No. 14: *What will be the public and private county resource requirements for contract implementation, if known (e.g., housing, local labor, public services/utilities, etc.)?*

EPA Response: Again, it's unknown at this time what specific resources will be required to complete each phase of the remedy for OU1.

Comment No. 15: *What are EPA's plans for monitoring the effectiveness and success of contract deliverables?*

EPA Response: EPA anticipates sequentially monitoring each phase of the remedy prior to moving forward with the next phase. EPA contractors are routinely monitored and rated for successfully completing assigned tasks.

Comment No. 16: *What is the timetable/schedule for development and implementation of options and plans for mitigation and/or abatement of the other 4 OUs (site, groundwater, Hawe Creek and Hawe Creek tributaries)?*

EPA Response: Efforts are ongoing to characterize the additional OUs at the Site.

Comment No. 17: *The estimated cost of the preferred alternative for the OU1 plan is $21.9 million. Are there any (even ballpark) estimates for the total costs of the other 4 OUs? Is a proposed budget for the $21.9 million in expenditures for OU1 available for public review? What is the proposed breakdown of expenditures for OU1 by object class - labor, materials, contracts, overhead, etc.?*

EPA Response: The costs to remediate the additional OUs is currently unknown.

Comment No. 18: *Are the amounts and availabilities of Superfund resources for completing these planning and abatement/mitigation projects expected to be available in the future without significant delays in allocations? If not, what will be the environmental consequences of delays in funding the feasibility studies, and the development, review and implementation of these plans?*

EPA Response: Efforts are ongoing to characterize the additional OUs at the Site.

Comment No. 19: *In general, what public information programs will be implemented by DHEC and/or EPA in carrying out the actions listed in the previous questions and in keeping the public informed of progress and program success?*

EPA Response: EPA conducts a range of community involvement activities to solicit community input and to make sure the public remains informed about site activities throughout the Superfund cleanup process. Outreach efforts have included fact sheets, public notices and public meetings. For questions regarding Site activities please look for updates on the site profile pages at https://www.epa.gov/superfund/barite-hill-nevada-goldfields, or reach out to us directly, Community Involvement Coordinator, Abena Moore (404) 562-8834 and Remedial Project Manager, Candice Teichert, (404) 562-8821.

Comment No. 20: *What costs for the mitigation and abatement plans for all 5 OUs will be paid by EPA, EPA Superfund resources and/or other Federal sources, and what costs, if any, will need to come from state and/or county funding? If state and/or county funding will be required for any aspect of these projects, what are those estimated costs and how will they be secured?*

EPA Response: The Barite Hill / Nevada Goldfields site is a Fund-financed cleanup. The Superfund law requires States to contribute (or share) at least 10 percent of thecosts to clean up NPL sites (Fund-financed sites) within their borders.

TABLES

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Table 1: Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations - Soil

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Minimum	Maximum					
Area Surrounding Pit Lake	Arsenic	5	28	mg/kg	6/6	28	mg/kg	Max
	Chromium*	9.2	100	mg/kg	6/6	100	mg/kg	Max

Key

mg/kg: Micrograms per kilogram
Max: Maximum Concentration
*: Chromium evaluated as Chromium VI

Table 2: Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations - Surface Water

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Minimum	Maximum					
Area Surrounding Pit Lake	Arsenic	0.87 J	169	µg/L	21/21	59.3	µg/L	95% UCL
	Cadmium	0.13 J	524	µg/L	21/21	137	µg/L	95% UCL
	Chromium*	0.91 J	86.9	µg/L	21/21	15.2	µg/L	95% UCL
	Cobalt	2.3 J	651 J	µg/L	21/21	175	µg/L	95% UCL
	Copper	11.9 J	62,000	µg/L	21/21	15,913	µg/L	95% UCL
	Iron	160 J	1,540,000	µg/L	21/21	811,509	µg/L	95% UCL
	Manganese	6,400	18,300	µg/L	21/21	26,702	µg/L	95% UCL

Key

µg/L: Micrograms per liter
J: Estimated Concentration
95% UCL: 95% Upper Confidence Limit
*: Chromium evaluated as Chromium VI

Table 3: Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations - Groundwater

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Minimum	Maximum					
Area Surrounding Pit Lake	Aluminum	110	1,600,000	µg/L	19/23	1,600,000	µg/L	Max
	Antimony	8	68	µg/L	8/23	68	µg/L	Max
	Arsenic	2.9	8,700	µg/L	13/23	8,700	µg/L	Max
	Cadmium	0.45	2,600	µg/L	19/23	2,600	µg/L	Max
	Chromium VI	1.6 J	1.6 J	µg/L	1/5	1.6	µg/L	Max
	Cobalt	19	4,700	µg/L	17/23	4,700	µg/L	Max
	Copper	12	800,000	µg/L	18/23	800,000	µg/L	Max
	Iron	120	6,800,000	µg/L	19/23	6,800,000	µg/L	Max
	Lead	0.85	1,000	µg/L	16/23	1,000	µg/L	Max
	Manganese	6.6	57,000	µg/L	21/23	57,000	µg/L	Max
	Nickel	21	2,100	µg/L	17/23	2,100	µg/L	Max
	Selenium	5.3	310	µg/L	19/23	310	µg/L	Max
	Thallium	1	5	µg/L	10/23	5	µg/L	Max
	Vanadium	6.8	1,100	µg/L	14/23	1,100	µg/L	Max
	Zinc	10	130,000	µg/L	22/23	130,000	µg/L	Max

Key

µg/L - Micrograms per liter
J - Estimated Concentration
Max: Maximum Concentration
The maximum groundwater concentration for manganese was obtained from well BH64. However, maximum groundwater concentrations for the other COCs were obtained from the most contaminated wells in the center of the plume (i.e., wells BH26 through BH-29).

Table 4: Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal						
Chemical of Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence/Cancer Guideline Description**	**Source**	**Date**
Aluminum	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Antimony	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Arsenic	1.5E+00	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	4/2017
Cadmium (diet)	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Cadmium (water)	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Chromium VI	5.0E-01	2.0E+01	$(mg/kg/day)^{-1}$	"Suggestive"	CalEPA	4/2018
Cobalt	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Copper	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Iron	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Lead	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Manganese (non diet)	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Nickel	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Selenium	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Thallium	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Vanadium	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017
Zinc	NA	NA	$(mg/kg/day)^{-1}$	NA	NA	4/2017

Pathway: Inhalation							
Chemical of Concern	**Unit Risk**	**Units**	**Inhalation CancerSlope Factor**	**Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date**
Aluminum	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Antimony	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Arsenic	4.3E-03	$(mg/m^3)^{-1}$	NA	NA	A	IRIS	4/2017
Cadmium (diet)	NA	$(mg/m^3)^{-1}$	NA	NA	B1	IRIS	4/2017
Cadmium (water)	NA	$(mg/m^3)^{-1}$	NA	NA	B1	IRIS	4/2017
Chromium VI	8.4E-02	$(mg/m^3)^{-1}$	NA	NA	"Suggestive"	IRIS	4/2018
Cobalt	9.0E-03	$(mg/m^3)^{-1}$	NA	NA	"Likely"	PPRTV	4/2017
Copper	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Iron	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Lead	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Manganese (non diet)	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Nickel	2.6E-04	$(mg/m^3)^{-1}$	NA	NA	NA	CalEPA	4/2017
Selenium	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Thallium	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Vanadium	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017
Zinc	NA	$(mg/m^3)^{-1}$	NA	NA	NA	NA	4/2017

Key

EPA Cancer Group (EPA, 2005)
- A - Known human carcinogen
- B1 - Probable human carcinogen, limited human data are available
- "Likely" - Likely to be carcinogenic to humans by the inhalation route

IRIS: Integrated Risk Information System
PPRTV: Provisional Peer Reviewed Toxicity Value
CalEPA: California Environmental Protection Agency
mg/kg/day: Microgram per kilogram per day
mg/m^3 microgram per cubic meter

Table 5: Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal									
Chemical Of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Dermal RfD	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ
Aluminum	Chronic	1.0E+00	mg/kg-day	1.0E+00	mg/kg-day	CNS	100	PPRTV	4/2017
Antimony	Chronic	4.0E-04	mg/kg-day	6.0E-05	mg/kg-day	Life span, Blood	1000	IRIS	4/2017
Arsenic	Chronic	3.0E-04	mg/kg-day	3.0E-04	mg/kg-day	Skin, Vascular	3	IRIS	4/2017
Cadmium (diet)	Chronic	1.0E-03	mg/kg-day	2.5E-05	mg/kg-day	Kidney	10	IRIS	4/2017
Cadmium (water)	Chronic	5.0E-04	mg/kg-day	2.5E-05	mg/kg-day	Kidney	10	IRIS	4/2017
Chromium VI	Chronic	3.0E-03	mg/kg-day	7.5E-05	mg/kg-day	None (NOAEL)	900	IRIS	4/2018
Cobalt	Chronic	3.0E-04	mg/kg-day	3.0E-04	mg/kg-day	Thyro d	3000	PPRTV	4/2017
Copper	Chronic	4.0E-02	mg/kg-day	4.0E-02	mg/kg-day	GI Tract	NA	HEAST	4/2017
Iron	Chronic	7.0E-01	mg/kg-day	7.0E-01	mg/kg-day	GI Tract	1.5	PPRTV	4/2017
Lead	Chronic	NA	mg/kg-day	NA	mg/kg-day	NA	NA	NA	4/2017
Manganese (non diet)	Chronic	2.4E-02	mg/kg-day	9.6E-04	mg/kg-day	CNS	1	IRIS	4/2017
Nickel	Chronic	2.0E-02	mg/kg-day	8.0E-04	mg/kg-day	Decreased body and organ weights	300	IRIS	4/2017
Selenium	Chronic	5.0E-03	mg/kg-day	5.0E-03	mg/kg-day	Nervous, Hematologic, Dermal		IRIS	4/2017
Thallium	Chronic	1.0E-05	mg/kg-day	1.0E-05	mg/kg-day	Skin	3000	PPRTV-A	4/2017
Vanadium	Chronic	5.0E-03	mg/kg-day	1.3E-04	mg/kg-day	Hair	100	IRIS	4/2017
Zinc	Chronic	3.0E-01	mg/kg-day	3.0E-01	mg/kg-day	Blood	3	IRIS	4/2017
Pathway: Inhalation									
Chemical Of Concern	Chronic/ Subchronic	Inhalation RfC	Inhalation RfC Units	Inhalation RfD	Inhalation RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ
Aluminum	Chronic	5.0E-03	mg/m^3	NA	mg/m^3	CNS	300	PPRTV	4/2017
Antimony	Chronic	NA	mg/m^3	NA	mg/m^3	NA	NA	NA	4/2017
Arsenic	Chronic	1.5E-05	mg/m^3	NA	mg/m^3	Reprod, Develop, CVS, CNS, Respir, Skin	30	CalEPA	4/2017
Cadmium (diet)	Chronic	1.0E-05	mg/m^3	NA	mg/m^3	Kidney	9	ATSDR-MRL	4/2017
Cadmium (water)	Chronic	1.0E-05	mg/m^3	NA	mg/m^3	Kidney	9	ATSDR-MRL	4/2017
Chromium VI	Chronic	1.0E-04	mg/m^3	NA	mg/m^3	Respiratory (Lung)	300	IRIS	4/2018
Cobalt	Chronic	6.0E-06	mg/m^3	NA	mg/m^3	Respiratory	300	PPRTV	4/2017
Copper	Chronic	NA	mg/m^3	NA	mg/m^3	NA	NA	NA	4/2017
Iron	Chronic	NA	mg/m^3	NA	mg/m^3	NA	NA	NA	4/2017
Lead	Chronic	NA	mg/m^3	NA	mg/m^3	NA	NA	NA	4/2017
Manganese (non diet)	Chronic	5.0E-05	mg/m^3	NA	mg/m^3	CNS	1000	IRIS	4/2017
Nickel	Chronic	9.0E-05	mg/m^3	NA	mg/m^3	Respiratory	NA	ASTDR	4/2017
Selenium	Chronic	2.0E-02	mg/m^3	NA	mg/m^3	Liver, CNS, CVS	3	CalEPA	4/2017
Thallium	Chronic	NA	mg/m^3	NA	mg/m^3	NA	NA	NA	4/2017
Vanadium	Chronic	1.0E-04	mg/m^3	NA	mg/m^3	Respiratory	30	ATSDR-MRL	4/2017
Zinc	Chronic	NA	mg/m^3	NA	mg/m^3	NA	NA	NA	4/2017

Key

ATSDR-MRL: Agency for Toxic Substances and Disease Registry Minimal Risk Level
HEAST: Health Effects Assessment Summary Tables
IRIS: Integrated Risk Information System
mg/kg-day: Milligrams per kilogram per day
mg/m^3: Milligram per cubic meter
NA - not available
PPRTV - Provisional Peer Reviewed Toxicity Value
PPRTV-A - value from Appendix A of the Provisional Peer Reviewed Toxicity Value support document

Table 6: Summary of Cancer Risk - Industrial Worker

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Area Around Pit Lake	Arsenic	4.9E-02	NA	- -	5E-02
			Chromium VI	3.1E-06	NA	- -	3E-06
						Groundwater Risk Total =	**5E-02**

Key

*: Chromium evaluated as Chromium VI
- -: Route of exposure is not applicable to this medium.
NA: Toxicity criteria are not available to quantitatively address this route of exposure.

Table 7: Summary of Cancer Risk - Resident

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Soil	Area Surrounding Pit Lake	Arsenic	3.6E-05	5.1E-06	3.2E-08	4.1E-05
			Chromium**	3.1E-04	NA	4.4E-06	3.1E-04
						Surface Soil Risk Total=	4E-04
Surface Water	Surface Water	Pit Lake	Arsenic	1.2E-05	2.7E-06	--	1.4E-05
			Chromium**	3.7E-06	4.6E-05	--	4.9E-05
						Surface Water Risk Total =	6E-05
Groundwater	Groundwater	Area Surrounding Pit Lake	Arsenic	1.5E-01	8.9E-04	- -	1.6E-01
			Chromium VI	2.5E-05	9.5E-06	- -	3.5E-05
						Groundwater Risk Total =	1.6E-01
						Total Risk =	2E-01

Key

** Chromium evaluated as Chromium VI

- -: Route of exposure is not applicable to this medium.

NA: Toxicity criteria are not available to quantitatively address this route of exposure.

Table 8: Summary of Non-Cancer Risk - Industrial Worker

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic-Hazard Quotient			
					Ingestion	Dermal	Inhalation Fugitive Dust	Exposure Route Totals
Groundwater	Groundwater	Area Surrounding Pit Lake	Aluminum	CNS	17	NA	- -	17
			Antimony	Life span, Blood	2	NA	- -	2
			Arsenic	Skin, Vascular	310	NA	- -	310
			Cadmium	Kidney	56	NA	- -	56
			Cobalt	Thyroid	168	NA	- -	168
			Copper	GI Tract	214	NA	- -	214
			Iron	GI Tract	104	NA	- -	104
			Lead	NA	NA	NA	- -	NA
			Manganese	CNS	25	NA	- -	25
			Nickel	Decreased body and organ weights	1	NA	- -	1
			Selenium	Nervous, Hematologic, Dermal	0.7	NA	- -	0.7
			Thallium	Skin	5	NA	- -	5
			Vanadium	Hair	2	NA	- -	2
			Zinc	Blood	5	NA	- -	5
							Groundwater Hazard Index Total =	**911**
							CNS Hazard Index =	**43**
							Blood Hazard Index =	**5**
							Skin, Vascular Hazard Index =	**310**
							Kidney Hazard Index =	**56**
							Thyroid Hazard Indes =	**168**
							GI Tract Hazard Index =	**318**
							Hair Hazard Index =	**8**
							Total Lifespan Hazard Index =	**2**
							Total Decreased Body weight Hazard Index =	**1**

Key

- -: Route of exposure is not applicable to this medium.
NA: Toxicity criteria are not available to quantitatively address this route of exposure.

Table 9: Summary of Non-Cancer Risk -Construction Worker

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic-Hazard Quotient			
					Ingestion	Dermal	Inhalation Fugitive Dust	Exposure Route Totals
Groundwater	Groundwater	Area Around Pit Lake	Cadmium	Kidney	0.1	1	- -	1.1
			Copper	GI Tract	1.6	0.7	- -	2.4
			Iron	GI Tract	0.2	0.1	- -	0.3
							Groundwater Hazard Index Total =	**4**
							Kidney Hazard Index =	**1**
							GI Tract Hazard Index =	**3**

Key

- -: Route of exposure is not applicable to this medium.

Table 10: Summary of Non-Cancer Risk – Trespasser/Recreational User

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic-Hazard Quotient			
					Ingestion	Dermal	Inhalation Fugitive Dust	Exposure Route Totals
Surface Water	Surface Water	Pit Lake	Aluminum	CNS	0.01	0.0007	- -	0.01
			Arsenic	Skin, Vascular	0.06	0.004	- -	0.07
			Cadmium	Kidney	0.09	0.11	- -	0.2
			Cobalt	Thyroid	0.2	0.005	- -	0.2
			Copper	GI Tract	0.1	0.008	- -	0.1
			Iron	GI Tract	0.4	0.024	- -	0.4
			Lead	NA	NA	NA	- -	NA
			Manganese	CNS	0.2	0.4	- -	0.63
			Vanadium	Hair	0.01	0.02	- -	0.03
			Zinc	Blood	0.006	0.0002	- -	0.006
			Cyanide	Testes	0.007	0.0004	- -	0.007
			Surface Water Hazard Index Total =					**2**

Key

- -: Route of exposure is not applicable to this medium.
NA: Toxicity criteria are not available to quantitatively address this route of exposure.

Table 11: Summary of Non-Cancer Risk - Resident

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic-Hazard Quotient: Ingestion	Dermal	Inhalation Fugitive Dust	Exposure Route Totals
Groundwater	Groundwater	Area Surrounding Pit Lake	Aluminum	CNS	55	0.3	- -	56
			Antimony	Life span, Blood	6	0.2	- -	6
			Arsenic	Skin, Vascular	1003	5	- -	1009
			Cadmium	Kidney	180	19	- -	199
			Cobalt	Thyroid	540	1	- -	541
			Copper	GI Tract	690	4	- -	694
			Iron	GI Tract	336	2	- -	338
			Lead	NA	NA	NA	- -	NA
			Manganese	CNS	52	7	- -	59
			Nickel	Decreased body and organ	4	0.1	- -	4
			Selenium	Nervous, Hematologic, Dermal	2	0.01	- -	2
			Thallium	Skin	17	0.09	- -	17
			Vanadium	Hair	8	2	- -	9
			Zinc	Blood	15	0.05	- -	15
							Groundwater Hazard Index Total =	**2949**
							CNS Hazard Index =	**118**
							Life Span Hazard Index =	**6**
							Blood Hazard Index =	**21**
							Skin, Vascular Hazard Index =	**1009**
							Kidney Hazard Index =	**199**
							Thyroid Hazard Indes =	**541**
							GI Tract Hazard Index =	**1032**
							Hair Hazard Index =	**26**
							Total Decreased Body weight Hazard Index =	**4**

Key

- -: Route of exposure is not applicable to this medium.
NA: Toxicity criteria are not available to quantitatively address this route of exposure.

Table 12. OU1 Media Exposure Point Concentrations (BERA)

Exposure Point	Chemical of Concern	Concentration Detected		Frequency of Detection	Units	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Minimum	Maximum					
Pit Lake	Aluminum	29.4 J	227,000	18/21	µg/L	77,620	µg/L	95% UCL
	Cadmium	0.13 J	524	21/21	µg/L	136	µg/L	95% UCL
	Copper	11.9 J	62,000	21/21	µg/L	15,910	µg/L	95% UCL
	Iron	160 j	1,540,000	21/21	µg/L	811,830	µg/L	95% UCL
Sediment in Pit Lake	Barium	430 J,O	1,120 J	6/6	mg/kg	1,120	mg/kg	Max
	Cadmium	1.3	73 J	6/6	mg/kg	73	mg/kg	Max
	Copper	240	1,980 J	6/6	mg/kg	1,980	mg/kg	Max

Key

95% UCL: 95% upper confidence level on the arithmetic mean
Max: Maximum concentration
mg/kg: milligrams per kilogram
µg/L: micrograms per liter

Table 13: Cleanup Levels for Barite Hill OU1

Ecological Based Remedial Goal			
Chemical of Concern	**Remedial Goal**		**Basis**
Water Within the Pit Lake (µg/L)			
Aluminum	86,000		Black & Veatch, 2017
Copper	14,000		EPA Region 4
Iron	30,000		Black & Veatch, 2017
Pit Water Discharging from the Pit Lake into the North Tributary (µg/L)	Acute	Chronic	
Aluminum (pH 6.5 - 9.0)	750	87	EPA, 2006
Iron	-	1,000	EPA, 2006
Cadmium	1.8	0.72	EPA, 2007
Copper	3.8	2.9	SCDHEC, 2014

Human Health Based Remedial Goal		
Chemical of Concern	**Remedial Goal**	**Basis**
Groundwater Discharging Through Seeps into the North Tributary (µg/L)		
Cadmium	5[1]	SCDHEC, 2014
Cobalt	794	Black & Veatch, 2018
Manganese	50[2]	EPA, 2006
Pit Water Discharging from the Pit Lake into the North Tributary (µg/L)		
Cadmium	5[1]	SCDHEC, 2014
Cobalt	794	Black & Veatch, 2018
Copper	1,300[2]	SCDHEC, 2014

Notes:

Black & Veatch, 2018 - Remedial Investigation Report Revision 1, Barite Hill OU1

Black & Veatch, 2018 - Human Health Risk Assessment Revision 1, Barite Hill OU1 (for residential HQ=1)

Black & Veatch, 2017 - Baseline Ecological Risk Assessment Revision 0, Barite Hill OU1

EPA, 2006 - National Recommended Water Quality Criteria for Non Priority Pollutants

EPA Region 4 - Recommended value based on LOAEL of 6.79 and water ingestion rate of a shrew (0.48 L water/kg bw/d)

SCDHEC, 2014 - SCR.61-68, Water Classifications and Standards

1 - maximum contaminant level

2 - Human Health for Consumption of Water and Organism

a - COCs based on human health; included to be protective of ecological receptors.

Table 14: Chemical-Specific ARARs

Action/Media	Requirements	Prerequisite	Citation(s)
Protection of surface water	Freshwaters (FW) are freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses.	Surface waters classified as Class FW (fresh waters) – **relevant and appropriate**	SC R. 61-68.G.10
	Quality Standards for FW: b. No treated wastes, toxic wastes, deleterious substances, colored or other wastes, alone or in combination with other substances or wastes, in sufficient amounts to make the waters unsafe or unsuitable for primary contact recreation or to impair the waters for any other best usage as determined for the specific waters which are assigned to this class. c. Toxic pollutants listed in the *Appendix* [in SC R. 61-68] must meet the standards as prescribed in Section E of this regulation.		SC R. 61-68.G.10.b and c
	All ground waters and surface waters of the State shall at all times, regardless of flow, be free from: (d) High temperature, toxic, corrosive, or deleterious substances attributable to sewage, industrial waste, or other waste in concentrations or combinations which interfere with classified water uses, existing water uses, or which are harmful to human, animal, plant or aquatic life.		SC R. 61-68.E.5(d)
	Numeric criteria for the protection and maintenance of all classes of surface waters are adopted and are listed in Sections E, G, and the *Appendix*. b. Application of numeric criteria to protect human health. (1) If separate numeric criteria are given for organism consumption, water and organism consumption (W/O), and drinking water Maximum Contaminant Levels (MCLs), they shall be applied as appropriate. The *most stringent* of the criteria *shall be applied* to protect the existing and classified uses of the waters of the State.		SC R. 61-68.E.14.b.
	Numerical water quality standards (maximum permissible levels): - Cadmium = 5 µg/L (MCL) - Copper = 1300 µg/L (W/O)		SC R. 61-68. *Appendix:* Water Quality Criteria for Protection of Aquatic Life and Human Health

Table 14: Chemical-Specific ARARs

Action/Media	Requirements	Prerequisite	Citation(s)
Protection of Surface Water *(discharges of pit water in spillway overflow event)*	Any discharge into waters of the State must be permitted by the Department and receive a degree of treatment and/or control which shall produce an effluent which is consistent with the Act, the Clean Water Act (P.L. 92-500, 95-217, 97-117, 100-4), this regulation, and related regulations. *Note:* Under CERCLA Section 121(e) permits are not required for on-site response actions. Instead discharges must meet any applicable effluent limits or other substantive requirements to protect the water quality of the receiving water.	Discharge of pollutants (including toxic substances) into waters of the State– **relevant and appropriate**	SCDHEC R. 61-68E.4.a

Table 15: Location-Specific ARARs

Location Characteristic(s)	Requirements	Prerequisite	Citation(s)
Location encompassing aquatic ecosystem as defined in 40 *CFR* 230.3(c)	Except as provided under CWA §404(b)(2), no discharge of dredged or fill material is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the United States.	Actions that involves discharge of dredged or fill material into *waters of the United States* including jurisdictional wetlands – **relevant and appropriate**	40 *CFR* 230.10(a) and (c)
	Except as provided under CWA §404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem. 40 CFR 230.70 et seq. identifies such possible steps.		40 CFR 230.10(d)
Nationwide Permit Program	Must comply with the substantive requirements of the NWP 38, General Conditions, as appropriate.	Discharge of dredged or fill material into *waters of the United States*, including jurisdictional wetlands – **relevant and appropriate**	Nationwide Permit (38) – Cleanup of Hazardous and Toxic Waste 33 *CFR* 323.3(b)
Presence of wetlands	Requires Federal agencies to evaluate action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance beneficial values of wetlands.	Actions that involve potential impacts to, or take place within, wetlands – **TBC**	Executive Order11990 – *Protection of Wetlands* - Section 1(a)
Presence of floodplains	Shall consider alternatives to avoid, to the extent possible adverse effects and incompatible development in the floodplain.	Federal actions that involve potential impacts to, or take place within, floodplains –**TBC**	Executive Order 11988– *Floodplain Management* Section 2. (a)(2)

Notes:
ARAR = applicable or relevant and appropriate requirement
CWA = Clean Water Act
CFR = *Code of Federal Regulations*
EPA = U.S. Environmental Protection Agency
SCDHEC = South Carolina Department of Health and Environmental Control
TBC = to be considered

Action	Requirements	Prerequisite	Citation
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)			
Managing storm water runoff from land-disturbing activities	Must comply with the substantive requirements for stormwater management and sediment control of *NPDES Construction General (CG) Permit for Stormwater Discharges No. SCR100000, issued under R.122.8 and developed consistent with the conditions in R.61-9.122.41 applicable to all permits.*	Large and small construction activities (as defined in R. 61-9 and SCR100000) of more than 1 acre of land – **applicable**	SCDHEC R. 61-9.122.41 and 122.28(a)(2)(i)
	Coverage under the CG Permit requires development of a stormwater management and sediment control plan which is to be consistent, at a minimum, to the substantive standards listed in SC Regulation 72-300, unless specifically exempted by SC Regulation 72-302.A	Large and small construction activities (as defined in R. 61-9 and SCR100000) of more than 1 acre of land – **TBC**	*NPDES Construction General (CG) Permit for Stormwater Discharges*, Permit No. SCR100000
	The stormwater management and sediment control plan shall contain at a minimum the information provided in the following subsections: • A plan for temporary and permanent vegetative and structural erosion and sediment control measures which specify the erosion and sediment control measures to be used during all phases of the land disturbing activity and a description of their proposed operation; • Provisions for stormwater runoff control during the land disturbing activity and during the life of the facility meeting the peak discharge rate and velocities requirements in subsections (e)1. and (e)2. of this section.	Activities involving more than two (2) acres and less than five (5) acres of actual land disturbance which are not part of a larger common plan of development or sale – **applicable**	SCDHEC R. 72-307I(3)(d) and (e) – *South Carolina Storm Water Management and Sediment Reduction Regulations*
Managing fugitive dust emissions from land disturbing activities	Emissions of fugitive particulate matter shall be controlled in such a manner and to the degree that it does not create an undesirable level of air pollution. Volatile organic compounds shall not be used for dust control purposes. Oil treatment is also prohibited.	Activities that will generate fugitive particulate matter (Statewide) –**applicable**	SCDHEC R. 61-62.6 Section III(a)- *Control of Fugitive Particulate Matter Statewide* SCDHEC R. 61-62.6 Section III(d)

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
	Underground Injection Well - Installation, Operation and Abandonment		
Injection of fluids, solids, or mixtures into subsurface *(e.g. in situ groundwater treatment)*	No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 *CFR* Part 142 or may otherwise adversely affect the health of persons.	Underground injection into an underground source of drinking water –**applicable**.	40 CFR 144.12(a)
	The movement of fluids containing wastes or contaminants into underground sources of drinking water as a result of injection is prohibited if the presence of the waste or contaminant: • May cause a violation of any drinking water standard underR61-58.5;or, • May otherwise adversely affect the health of persons. As defined in R.61-87.2: ''Fluid'' means material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state. ''Well'' means any excavation which is cored, bored, drilled, jetted, dug, or otherwise constructed the depth of which is greater than its largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or, a subsurface fluid distribution system.	Underground injection of any fluids into the subsurface or ground waters of the State of South Carolina – **applicable**.	SCDHEC R.61-87.5(A) and (B)
	No person shall construct, use or operate a Class V.A. well for injection in violation of R61-87.5. R.61-87.11(E)(1) - Class V.A. injection wells include: (g) Injection wells used in experimental technologies	Class V.A injection wells [as classified in R.61-87.11(E)(1)] – **applicable**	SCDHEC R.61-87.11(E)(2)(b)
Operation of underground injection wells	At a minimum, the following information concerning the injection formation shall be determined or calculated: (1) Fluid pressure; (2) Estimated fracture pressure; (3) Physical and chemical characteristics of the injection zone.	Operation of Class V.A. wells, [as classified in R.61-87.11(E)(1)] – **applicable**	SCDHEC R.61-87.14(D)

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
	Shall at all times properly operate and maintain all facilities and systems of treatment and controls which are installed or used.		SCDHEC R.61-87.13(X)
	Shall report malfunction of injection system which may cause fluid migration into or between underground sources of drinking water; shall immediately stop injection upon determination that the injection system has malfunctioned and could cause fluid migration into or between underground sources of drinking water; shall not restart the injection system until the malfunction has been corrected.		SCDHEC R.61-87.13(EE)
Monitoring of underground injection wells	An appropriate number of monitoring wells shall be completed into the injection zone and into any underground sources of drinking water which could be affected by the injection operation. These wells shall be located in such a fashion as to detect any excursion of injection fluids, process by-products, or formation fluids outside the injection area or zone. If the operation may be affected by subsidence or catastrophic collapse the monitoring wells shall be located so that they will not be physically affected.	Monitoring of Class V.A. wells, [as classified in R.61-87.11(E)(1)]– **applicable**	SCDHEC R.61-87.14(G)(1)
Closure of Class V underground injections wells	Wells must be closed in a manner that complies with the prohibition of fluid movement in 40 CFR 144.82(a)(l). Also, any soil, gravel, sludge, liquids, or other materials removed from or adjacent to the well must be disposed or otherwise managed in accordance with substantive applicable Federal, State, and local regulations and requirements.	Closure of Class V wells [as defined in 40 CFR 144.6(e)] – **applicable**	40 CFR 144.82(b)

Action	Requirements	Prerequisite	Citation
Monitoring Well Installation, Operation, and Abandonment			
Installation of Permanent and Temporary Monitoring Wells	All monitoring wells shall be drilled, constructed, maintained, operated, and/or abandoned to ensure that underground sources of drinking water are not contaminated.	Construction of permanent and temporary monitoring wells, as defined in R. 61-71B – **applicable**	SCDHEC R. 61-71H.1(b)
Installation of Permanent Conventionally Installed or Direct Push Monitoring Wells	Wells shall be grouted from the top of the bentonite seal to the land surface. Grout is to be composed of neat cement, a bentonite cement mixture, or high solids sodium bentonite grout.	Construction of permanent conventionally installed or direct push monitoring wells, as defined in R. 61-71B – **applicable**	SCDHEC R. 61-71H.2.a.(1),(2) *[conventionally installed wells]* SCDHEC R. 61-71H.3.b.(1),(2) *[direct push wells]*
	The diameter of the annular space shall be large enough to allow for forced injection of grout through a tremie pipe. All grouting shall be accomplished using forced injection to emplace the grout. When emplacing the grouting material, the tremie pipe shall be lowered to the bottom of the zone to be grouted. The tremie pipe shall be kept full continuously from start to finish of the grouting procedure, with the discharge end of the tremie pipe being continuously submerged in the grout until the zone to be grouted is completely filled.		SCDHEC R. 61-71H.2.a.(3),(4) *[conventionally installed wells]* SCDHEC R. 61-71H.3.b.(3),(4) *[direct push wells]*
	A cement or aggregate reinforced concrete pad at the ground surface of appropriate durability and strength, considering the setting and location of each well, that extends six inches beyond the borehole diameter and six inches below ground surface is required. The pad shall be capable of preventing infiltration between the surface casing and the borehole to the subsurface.		SCDHEC R. 61-71H.2.a.(5) *[conventionally installed wells]* SCDHEC R. 61-71H.3.b.(5) *[direct push wells]*

Action	Requirements	Prerequisite	Citation
Installation of Permanent Conventionally Installed or Direct Push Monitoring Wells (cont'd)	Well Construction and Materials Standards – **(1)** Casing shall be of sufficient strength to withstand normal forces encountered during and after well installation and be composed of material so as to minimally affect water quality analyses. **(2)** Casing shall have a sufficient diameter to provide access for sampling equipment. **(3)** A properly hydrated bentonite seal with a minimum thickness of twelve inches directly above the filter pack shall be used, if the well has a filter pack. **(4)** The monitoring well intake or screen design shall minimize formational materials from entering the well. The filter pack 17 shall be utilized opposite the well screen as appropriate in so that parameter analyses will be minimally affected. **(5)** A locking cap or other security devices to prevent damage and/or vandalism shall be used. **(6)** Monitoring wells completed below grade shall be in a watertight vault with a well cap to prevent infiltration of surface water into the well.	Construction of permanent conventionally installed or direct push monitoring wells, as defined in R. 61-71B – **applicable**	SCDHEC R. 61-71H.2.b. *[conventionally installed wells]* SCDHEC R. 61-71H.3.c *[direct push wells]*
	All monitoring wells shall be properly labeled with an identification plate immediately upon well completion. The identification plate shall be constructed of a durable, weatherproof, rustproof, material. The identification plate shall be permanently secured to the well casing or enclosure floor around the casing where it is readily visible and shall identify: (1) company name and certification number of the driller who installed the well; (2) date well was completed; (3) total depth (feet); (4) casing depth (feet); (5) screened Interval; (6) designator and/or identification number.		R. 61-71H.2.c. *[conventionally installed wells]* SCDHEC R. 61-71H.3.d *[direct push wells]*
Additional Requirements for Installation of Direct Push Monitoring Wells	Direct push wells cannot be installed below a confining layer unless it can be demonstrated to the satisfaction of the Department that cross-contamination of the aquifer systems can be prevented.	Construction of direct push monitoring wells, as defined in R. 61-71B – **applicable**	R. 61-71H.3.a.

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
Installation of *Temporary* Monitoring Wells	Construction and Materials – (1) Casing shall be of sufficient strength to withstand normal forces encountered during and after well installation and be 20 composed of material so as to minimally affect water quality analyses. (2) Casing shall have a sufficient diameter to provide access for sampling equipment. (3) The monitoring well intake or screen design shall minimize formational materials from entering the well. The filter pack or intake shall be utilized opposite the well screen as appropriate so that parameter analyses will be minimally affected.	Construction of *temporary* monitoring wells, as defined in R. 61-71B – **applicable**	SCDHEC R. 61-71H.4.a.
	All temporary monitoring wells shall be sealed with a watertight cap or seal until abandoned. Temporary monitoring wells shall be maintained such that they are not a source or channel of contamination before they are abandoned.	Operation and maintenance of *temporary* monitoring wells, as defined in R. 61-71B – **applicable**	SCDHEC R. 61-71H.4.b.
Abandonment of *Permanent Conventionally Installed* Monitoring Wells	Abandonment of permanent conventionally installed monitoring wells shall be by forced injection of grout or pouring through a tremie pipe starting at the bottom of the well and proceeding to the surface in one continuous operation. The well shall be filled with either with neat cement, bentonite-cement, or 20% high solids sodium bentonite grout, from the bottom of the well to the land surface.	Abandonment of *permanent conventionally installed* monitoring wells – **applicable**	SCDHEC R. 61-71H.2.e.
Abandonment of *Permanent Direct Push* Monitoring Wells	(1) Permanent direct push wells that do not penetrate a confining layer shall be abandoned by removing all casing from the subsurface and be grouted by forced injection through a tremie pipe from the total depth to the land surface, or by forced injection or pouring of neat cement, bentonite-cement, or 20% high solids sodium bentonite grout through a tremie pipe starting at the bottom of the well and proceeding to the surface. (2) Direct push wells that penetrate a confining layer shall be abandoned by forced injection or pouring of neat cement, bentonite-cement, or 20% high solids sodium bentonite grout through a tremie pipe starting at the bottom of the well and proceeding to the surface in one continuousoperation.	Abandonment of *permanent direct push* monitoring wells, as defined in R.61-71B – **applicable**	SCDHEC R. 61-71H.2.f.

Action	Requirements	Prerequisite	Citation
Abandonment of *Temporary* Conventionally Installed or Direct Push Monitoring Wells	**(1)** All temporary monitoring wells shall be abandoned within 5 days of borehole completion. **(2)** A conventionally drilled temporary well shall be abandoned by forced injection of neat cement, bentonite-cement, or 20% high solids sodium bentonite grout through a tremie pipe starting at the bottom of the well and proceeding to the surface in one continuous operation. **(3)** A temporary direct push well that does not penetrate a confining layer shall be abandoned by forced injection of neat cement, bentonite-cement, or 20% high solids sodium bentonite grout through a tremie pipe after the sampling device has been removed. **(4)** A temporary direct push well that penetrates a confining layer shall be abandoned by forced injection of neat cement, bentonite-cement, or 20% high solids sodium bentonite grout through the sampling device as the sampling device is removed from the sub-surface. Abandonment shall occur during the initial withdrawal from the original push borehole and not by a separate tremie tool after the sampling device has been removed to ensure the breech in the confining layer is permanently sealed.	Abandonment of *temporary* conventionally installed or direct push monitoring wells, as defined in R.61-71B – **applicable**	SCDHEC R. 61-71H.4.c.
Waste Characterization and Storage (e.g., soil cuttings from well installation, monitoring well purgewater, wastewaters)			
Characterization of solid waste	Must determine if solid waste is a hazardous waste using the following method: Should first determine if waste is excluded from regulation under 40 CFR §261.4; and	Generation of solid waste as defined in 40 CFR §261.2 – **applicable**	40 CFR §262.11(a) SCDHEC R. 61-79 §262.11*(a)*
	Must determine if waste is listed as hazardous waste under 40 CFR Part 261.	Generation of solid waste which is not excluded under 40 CFR §261.4(a) –**applicable**	40 CFR §262.11(b) SCDHEC R. 61-79 §262.11*(b)*
	Must determine whether the waste is (characteristic waste) identified in subpart C of 40 CFR Part 261 by either:	Generation of solid waste which is not excluded under 40 CFR §261.4(a) –**applicable**	40 CFR §262.11(c) SCDHEC R. 61-79 §262.11*(c)*

Action	Requirements	Prerequisite	Citation
	(1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR §260.21; or (2) Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used.		
Determinations for management of hazardous waste	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous waste –**applicable**	40 CFR §262.11(d) SCDHEC R. 61-79 §262.11*(d)*
	Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 *et seq.*. *Note:* This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter.	Generation of hazardous waste for storage, treatment or disposal – **applicable**	40 CFR 268.9(a) SCDHEC R. 61-79 268.9*(a)*
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal – **applicable**	40 CFR 268.9(a) SCDHEC R. 61-79 268.9*(a)*
	Must determine if the hazardous waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste. *Note:* This determination can be made concurrently with the hazardous waste determination required in 40 CFR 262.11.	Generation of hazardous waste for storage, treatment or disposal – **applicable**	40 CFR 268.7(a) SCDHEC R. 61-79 268.7*(a)* (1)

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
Temporary storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that: • waste is placed in containers that comply with 40 CFR 265.171-173; and • the date upon which accumulation begins is clearly marked and visible for inspection on each container • container is marked with the words "hazardous waste"; or	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10 – **applicable**	40 CFR 262.34(a)(1) and (2) SCDHEC R. 61-79 262.34*(a)* (1) and (2) 40 CFR 264.34(a)(3) SCDHEC R. 61-79 262.34*(a)* (3)
	• container may be marked with other words that identifythe contents.	Accumulation of 55 gal. or less of RCRA hazardous waste or 1 quart of acutely hazardous waste listed in 261.33(e) at or near any point of generation – **applicable**	40 CFR 262.34(c)(1) SCDHEC R. 61-79 262.34*(c)* (1)
Use and management of hazardous waste in containers	If container holding waste is not in good condition (e.g. severe rusting, structural defects), or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers – **applicable**	40 CFR 265.171 SCDHEC R. 61-79 265.171
	Must use a container made or lined with materials which will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired.		40 CFR 265.172 SCDHEC R. 61-79 265.172
	A container holding hazardous waste must always be closed during storage, except when necessary to add or remove waste. A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.		40 CFR 265.173(a) and (b) SCDHEC R. 61-79 265.173*(a)* and *(b)*

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 CFR 265.175(b).	Storage of RCRA hazardous waste in containers ***with free liquids*** – **applicable**	40 CFR 264.175(a) SCDHEC R. 61-79 264.175*(a)*
	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage of RCRA-hazardous waste in containers that ***do not contain free liquids*** (other than F020, F021, F022, F023, F026 and F027) – **applicable**	40 CFR 265.175(c)(1) and (2) SCDHEC R. 61-79 265.175*(c)* (1) and (2)
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed.	Storage of RCRA hazardous waste in containers in a unit with a containment system – **applicable**	40 CFR 264.178
Temporary on-site storage of remediation waste in staging piles (*e.g.*, excavated soils, waste rock)	Must be located within the contiguous property under the control of the owner/operator where the wastes are to be managed in the staging pile originated.	Accumulation of non-flowing hazardous remediation waste (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 C.F.R. § 260.10 – **applicable**	40 C.F.R. § 264.554(a)(1)
	May be temporarily stored, (including mixing, sizing, blending or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility if used only during remedial operations provided that the staging pile:		40 C.F.R. § 264.554(a)(1)
	must facilitate a reliable, effective and protective remedy;		40 C.F.R. § 264.554(d)(1)(i)
	must be designed to prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer as necessary to protect human health and the environment (*e.g.*, use of liners, covers, run-off/run-on controls); and		40 C.F.R. § 264.554(d)(1)(ii)

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
	• must not operate for more than 2 years, except when an operating term extension under 40 CFR 264.554(i) is granted. *Note:* Must measure the 2-year limit (or other operating term specified) from first time remediation waste placed in staging pile. • Must not use staging pile longer than the length of time designated by EPA in appropriate decision document		40 C.F.R. § 264.554(d)(1)(iii) 40 C.F.R. § 264.554(i)(1)
	Extension of up to an additional 180 days beyond the operating term limit may be granted provided the continued operation of the staging pile: • Will not pose a threat to human health and the environment; and Is necessary to ensure timely and efficient implementation of remedial actions at the facility.		40 CFR 264.554(i)(1)(i) and (ii)
	In setting standards and design criteria, must consider the following factors: • Length of time pile will be in operation; • Volumes of waste you intend to store in the pile; • Physical and chemical characteristics of the wastes to be stored in theunit; • Potential for releases from the unit; • Hydrogeological and other relevant environmental conditions at the facility that may influence the migration of any potential releases; and • Potential for human and environmental exposure to potential releasesfrom the unit.		40 C.F.R. § 264.554(d)(2)(i) –(vi)
Closure of staging piles of remediation waste	Must be closed within 180 days after the operating term by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate.	Storage of remediation waste in staging pile in *previously contaminated area* – **applicable**	40 C.F.R. §264.554(j)(1)
	Must decontaminate contaminated sub-soils in a manner that EPA determines will protect human and the environment.		40 C.F.R. §264.554(j)(2)

Action	Requirements	Prerequisite	Citation
	Must be closed within 180 days after the operating term according to 40 C.F.R. §§ 264.258(a) and 264.111, or 265.258(a) and 265.111.	Storage of remediation waste in staging pile in *uncontaminated area* – **applicable**	40 C.F.R. §264.554(k)
Waste treatment and disposal – (e.g., contaminated soils, wastewaters, monitoring well purge water)			
Disposal of solid waste	Shall ultimately dispose of solid waste at facilities and/or sites permitted or registered by the Department for processing or disposal of that waste stream.	Generation of solid waste intended for off-site disposal – **relevant and appropriate**	SCDHEC R. 61-107.5(D)(3)
Land disposal of RCRA-hazardous waste	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at § 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste – **applicable**	40 CFR 268.40(a) SCDHEC R. 61-79 §268.40*(a)*
Land disposal of RCRA-hazardous waste	All underlying hazardous constituents (as defined in 268.2(i)) must meet the Universal Treatment Standards, found in § 268.48, Table Universal Treatment Standards, prior to land disposal as defined in § 268.2(c).	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **applicable**	40 CFR 268.40(e) SCDHEC R. 61-79 §268.40*(e)*
	Must be treated according to the alternative treatment standards in 268.49(c) **<u>or</u>** must be treated according to the Universal Treatment Standards (UTS) [specified in 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils – **applicable**	40 CFR 268.49(b) SCDHEC R. 61-79 268.49*(b)*
	To determine whether a hazardous waste identified in this section exceeds the applicable treatment standards of 40 CFR 268.40, the initial generator must test a sample of the waste extract or the entire waste, depending on whether the treatment standards are expressed as concentration in the waste extract or waste, or the generator may use knowledge of the waste.	Land disposal of RCRA toxicity characteristic wastes (D004-D011) that are newly identified (i.e., wastes or soil identified by the TCLP but	40 CFR 268.34(f) SCDHEC R. 61-79 268.34*(f)*

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
	If the waste contains constituents (including UHCs in the characteristic wastes) in excess of the applicable UTS levels in 40 CFR 268.48, the waste is prohibited from land disposal, and all requirements of part 268 are applicable, except as otherwise specified.	not the Extraction Procedure) – **applicable**	
Discharge of Wastewater from On-Site Groundwater or Surface Water Treatment Unit			
Disposal of wastewaters into CWA wastewater treatment unit	Wastes that are hazardous only because they exhibit a hazardous characteristic, and which are otherwise prohibited under this part, are not prohibited [from land disposal] if the waste meet any of the following criteria, unless the wastes are subject to a specified method of treatment other than DEACT in §268.40, or are D003 reactive cyanide: (i) The wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under section 402 of the Clean Water Act [SC R.61-9 and R. 61-68]; or (ii) The wastes are treated for purposes of the pretreatment requirements of section 307 of the Clean Water Act [SC R. 61-9 and R.61-68]; or (iii) The wastes are managed in a zero discharge system engaged in Clean Water Act-equivalent treatment as defined in 268.37(a); and (iv) The wastes no longer exhibit a prohibited characteristic at the point of land disposal (i.e., placement in a surface impoundment).	Restricted RCRA characteristic hazardous wastewaters managed in a wastewater treatment system – **applicable**	40 CFR §268.1(c)(4) SCDHEC R. 61-79 §268.1(c)(4)
Transport and conveyance of collected RCRA wastewater to WWTU located on the facility	Any dedicated tank systems, conveyance systems, and ancillary equipment used to treat, store or convey wastewater to an on-site NPDES-permitted wastewater treatment unit (WWTU) are exempt from the requirements of RCRA Subtitle C standards. ***NOTE:*** For purposes of this exclusion, any dedicated tank systems, conveyance systems, and ancillary equipment used to treat, store or convey CERCLA remediation wastewater to a CERCLA on –site wastewater treatment unit that meets all of the identified CWA ARARs for point source	On-site wastewater treatment unit [as defined in 40 CFR 260.10] subject to regulation under §402 or §307(b) of the CWA (i.e., NPDES permitted) that manages hazardous wastewaters – **applicable**	40 CFR 264.1(g)(6)

	discharges from such a facility, are exempt from the requirements of RCRA Subtitle C standards.		
General duty to mitigate for discharge of WWTU	Take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of effluent standards which has a reasonable likelihood of adversely affecting human health or the environment.	Discharge of pollutants to surface waters – **applicable**	40 CFR § 122.41(d) SCDHEC R.61-9 §122.41(d)
	Properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the effluent standards. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures.	Discharge of pollutants to surface waters – **applicable**	SCDHEC R.61-9 §122.41(e)(1)
Technology-based treatment requirements for wastewater discharge	To the extent that EPA promulgated effluent limitations are inapplicable, State shall develop on a case-by-case basis under § 402(a)(1)(B) of the CWA, technology based effluent limitations by applying the factors listed in 40 CFR § 125.3(d) and shall consider: the appropriate technology for this category or class of point sources; and any unique factors relating to the discharger.	Discharge of pollutants to surface waters from other than a POTW – **applicable**	40 CFR § 125.3(c)(2) SCDHEC R.61-9 §125.3(c)(2)
Water quality based-effluent limits for wastewater discharge	Must develop water quality-based effluent limits that ensure that: The level of water quality to be achieved by limits on point sources(s) established under this paragraph is derived from, and complies with all applicable water quality standards; and Effluent limits developed to protect narrative or numeric water quality criteria are consistent with the assumptions and any available waste load allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR § 130.7.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water quality standard established under §303 of the CWA – **applicable**	40 CFR § 122.44(d)(1)(vii) SCDHEC R.61-9 § 122.44(d)(1)(vii)
Monitoring requirements for discharges from on-site WWTU	To measure compliance with effluent limitations, must monitor, as provided in subsections (i) thru (iv) of 122.44(i)(1). *NOTE: Monitoring parameters, including frequency of sampling, will be developed as part of the CERCLA process and included in a Remedial Design, Remedial Action Work Plan, or other appropriate CERCLA document.*	Discharge of pollutants to surface waters – **applicable**	40 CFR §122.44(i)(1) SCDHEC R.61-9 §122.44(i)(1)

	All effluent limitations, standards and prohibitions shall be established for each outfall or discharge point, except as provided under §122.44(k)		40 CFR §122.45(a) SCDHEC R.61-9

Table 16: Action-Specific ARARs

Action	Requirements	Prerequisite	Citation
Transportation of Wastes			
Transportation of hazardous waste *on-site*	The generator manifesting requirements of §262.20 and §262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in §§263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on public or private right-of-way within or along the border of contiguous property under control of same person – **applicable**	40 CFR §262.20(f) SCDHEC R. 61-79 §262.20*(f)*
Transportation of samples (i.e. solid waste, soils and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: • the sample is being transported to a laboratory for the purposeof testing; or • the sample is being transported back to the sample collectorafter testing. • the sample is being stored by sample collector before transporttoa lab for testing.	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition – **applicable**	40 CFR §261.4(d)(1)(i)-(iii) SCDHEC R. 61-79 §261.4*(d)* (1)
	In order to qualify for the exemption in 40 CFR 261.4 (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: • Comply with U.S. DOT, U.S. Postal Service, or any otherapplicable shipping requirements. • Assure that the information provided in (1) thru (5) of this section accompanies the sample. • Package the sample so that it does not leak, spill, or vaporize from its packaging.		40 CFR 261.4(d)(2) 40 CFR 261.4(d)(2) (ii)(A) and (B) SCDHEC R. 61-79 261.4*(d)* (2)(ii)(A) and (B)

Table 16: Action-Specific ARARs

Notes:
Alt = Alternative
ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
DEACT = deactivation
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
LDR = Land Disposal Restrictions
MCL = Maximum Contaminant Level under Safe Drinking Water Act
NPDES = National Pollutant Discharge Elimination System
RCRA = Resource Conservation and Recovery Act of 1976
SCDHEC = South Carolina Department of Health and Environmental Control
TBC = to be considered
TCLP = Toxicity Characteristic Leaching Procedure
UTS = Universal Treatment Standard

Table 17: Cost Comparison of OU1 Remedial Alternatives

Contaminated Media Zone and Remedial Alternatives		Total Capital Cost	Total O&M Cost	O&M Period (years)	Total Alternative Cost
CMZ-1, Pit Lake					
Pit Lake #1	No Action	$0	$94,200	30+	**$94,200**
Pit Lake #2	Drain Lake, Treat, Discharge to SW; Add Amendments to Pit Floor, Backfill Pit	$17,636,097	$142,394	30	**$17,778,500**
Pit Lake #3	Drain Pit Lake, Treat, Discharge to SW; Cap Pit Floor, Partial Backfill, Create Wetland	$14,394,139	$155,863	30	**$14,550,000**
Pit Lake #4	Amendments to Pit Lake, Cap Pit Floor	$9,224,251	$91,476	30	**$9,315,700**
CMZ-2, Waste Rock					
Waste Rock #1	No Action	$0	$91,100	30+	**$91,100**
Waste Rock #2	Excavate and On-Site Encapsulation of Waste Rock, Backfill Excavation and Cap	$14,258,471	$325,587	30	**$14,584,100**
Waste Rock #3	Amendments to Waste Rock, Enhance Existing Caps	$4,400,646	$79,079	30	**$4,479,700**
CMZ-3, OU1 Groundwater					
Groundwater #1	No Action	$0	$122,200	30+	**$122,200**
Groundwater #2A	Groundwater Diversion - Barrier Wall and Grout Curtain	$7,432,326	$74,495	30	**$7,506,800**
Groundwater #2B	Groundwater Diversion - Hydraulic Barrier	$1,995,286	$1,525,832	30	**$3,521,100**
Groundwater #3	Groundwater In-Situ Neutralization	$1,467,917	$5,253,119	30	**$6,721,000**

FIGURES

December 8, 2010

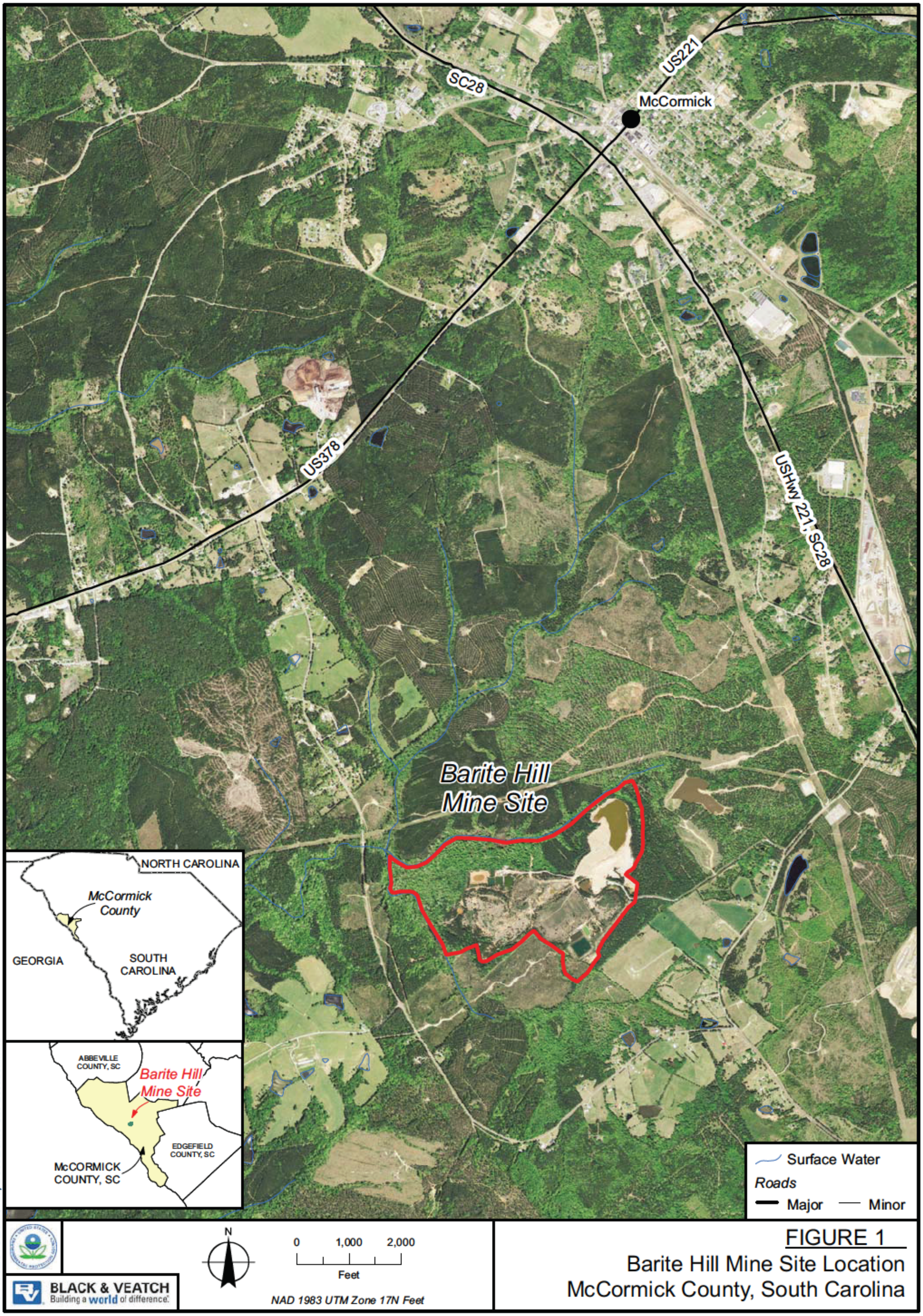

FIGURE 1

Barite Hill Mine Site Location

McCormick County, South Carolina

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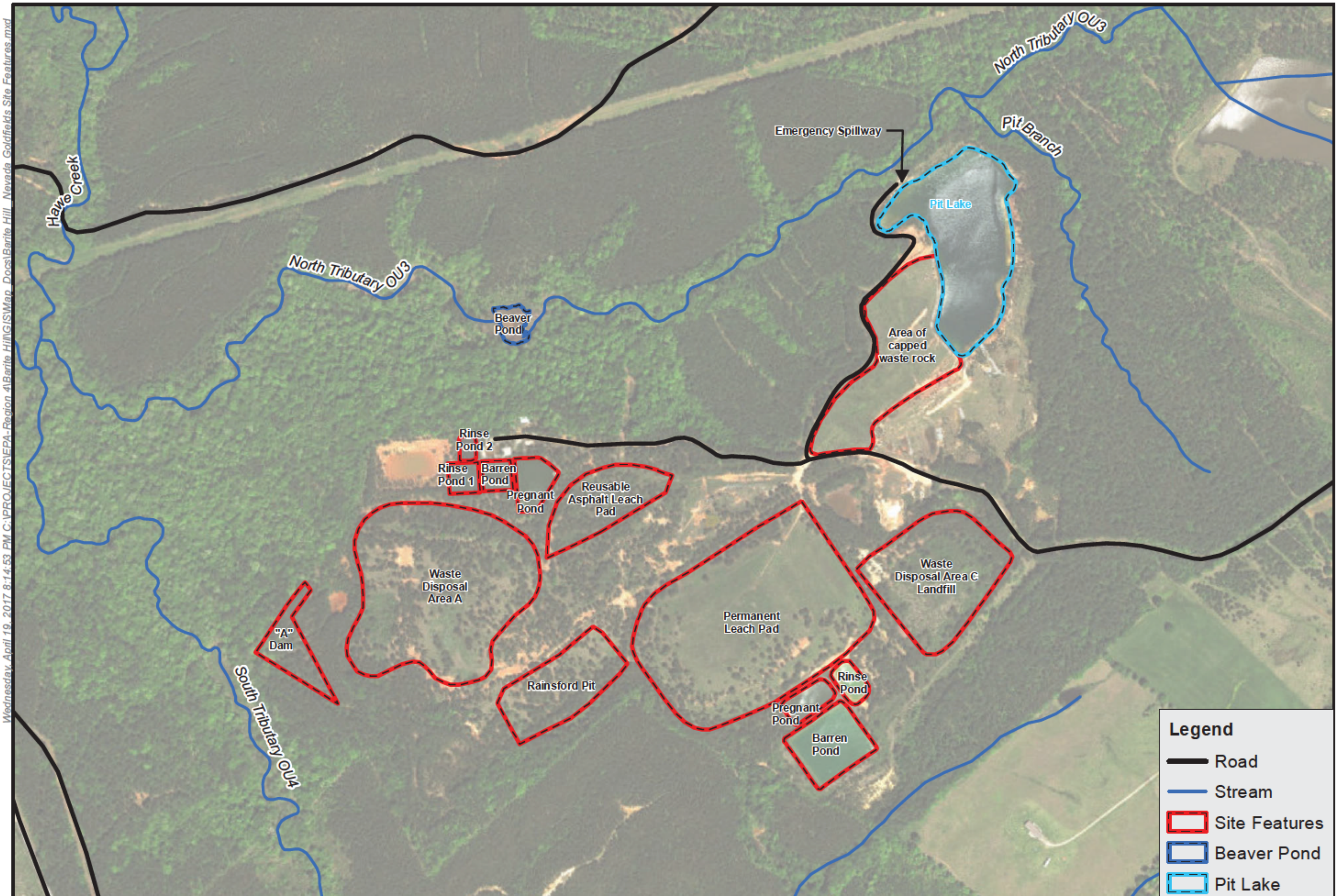

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FIGURE 2

Barite Hill / Nevada Goldfields Site Features

Barite Hill Mine, McCormick County, South Carolina

Figure 3. Barite Hill OU1 Geological Conceptual Site Model

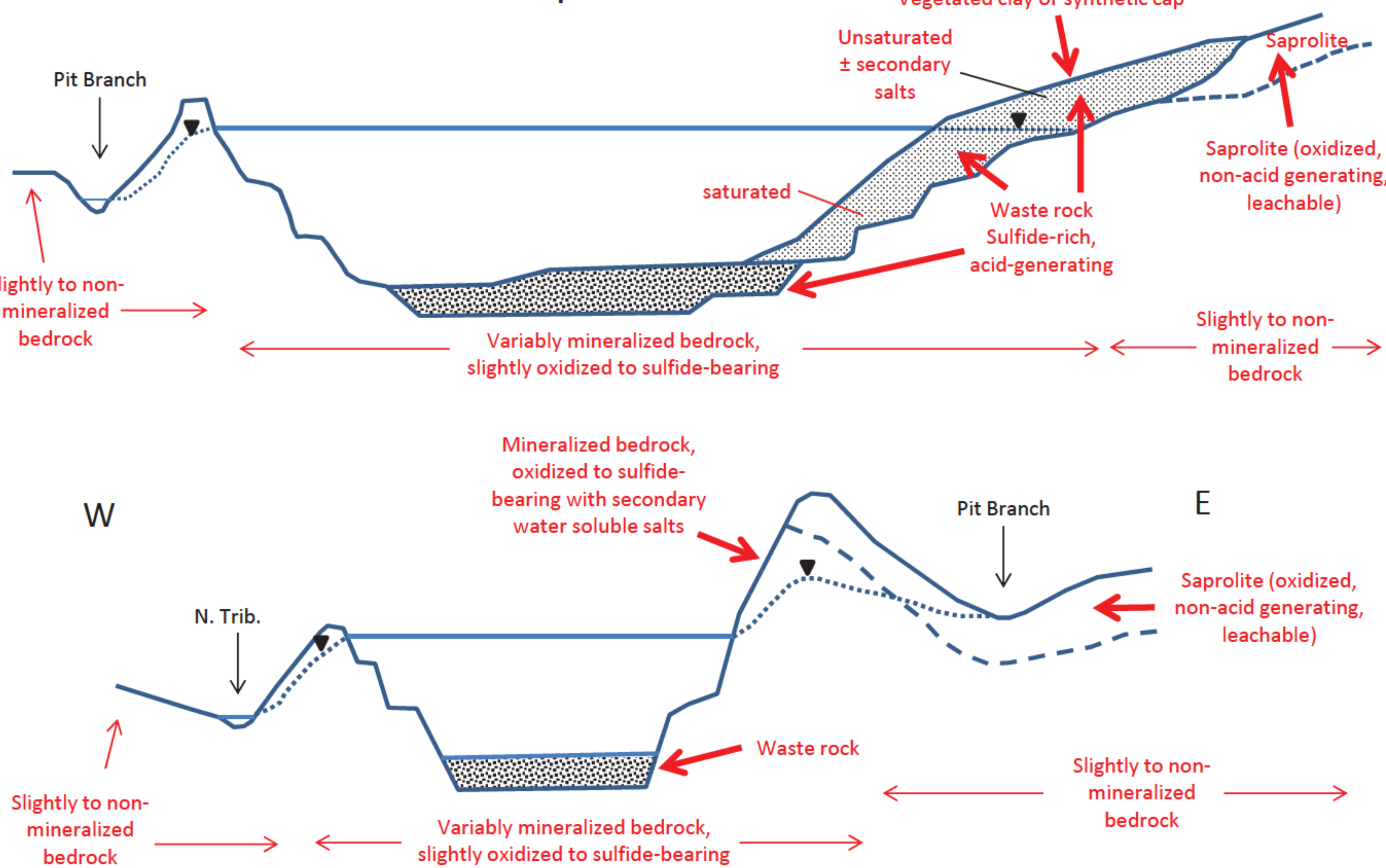


Figure 4. Barite Hill OU1 Geochemical Conceptual Site Model

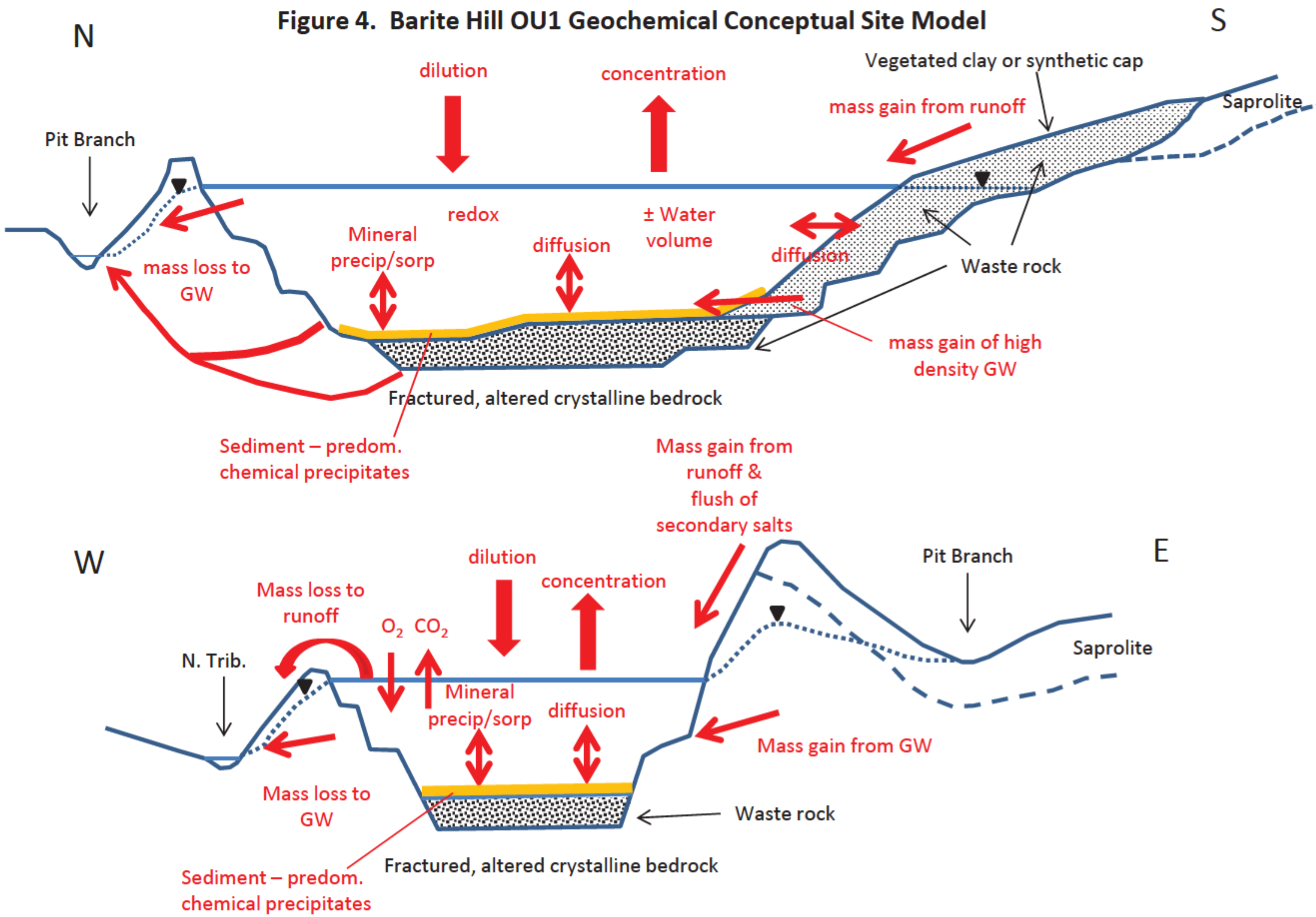


Figure 5. Barite Hill OU1 Hydrologic Conceptual Site Model

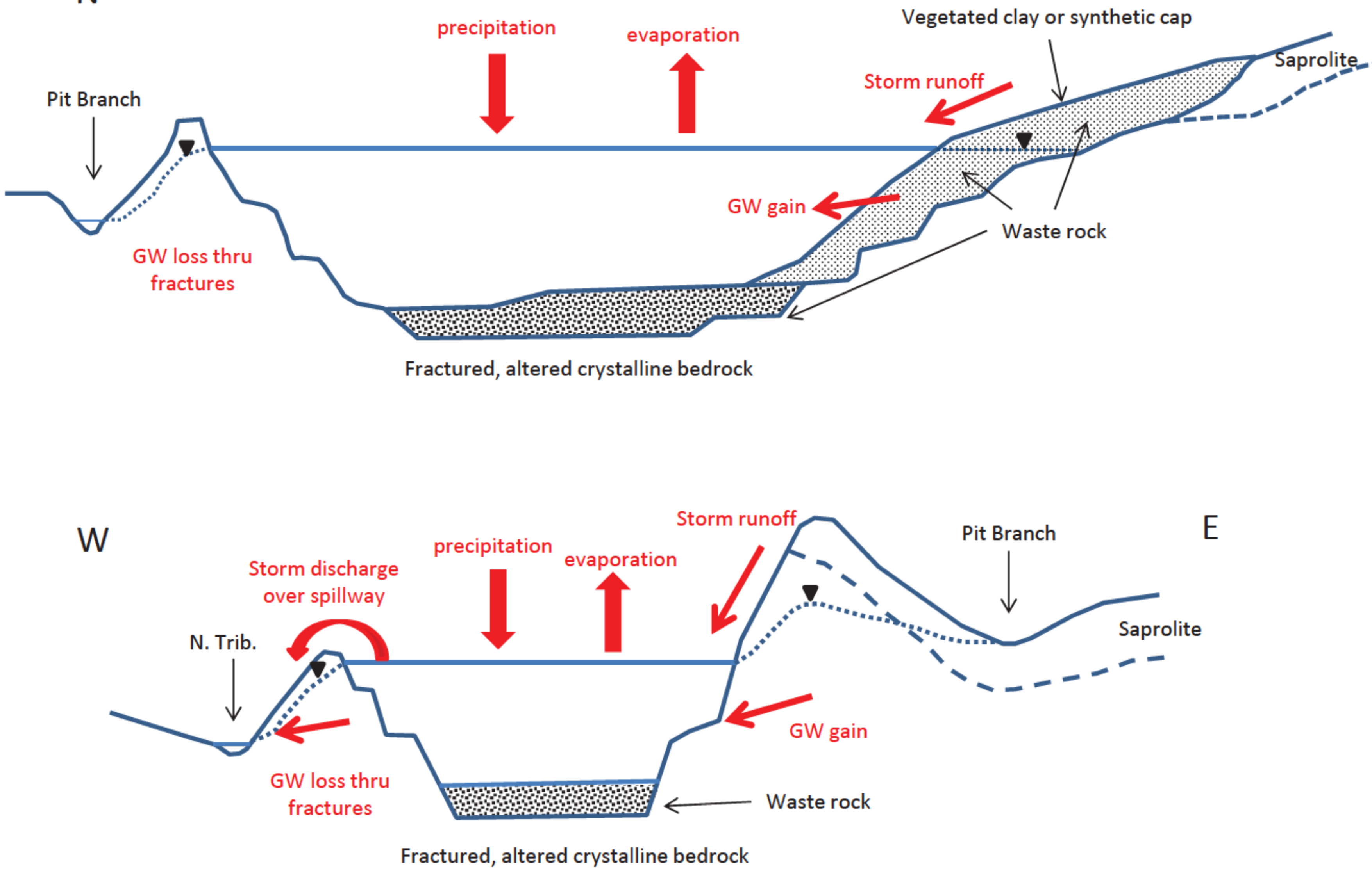
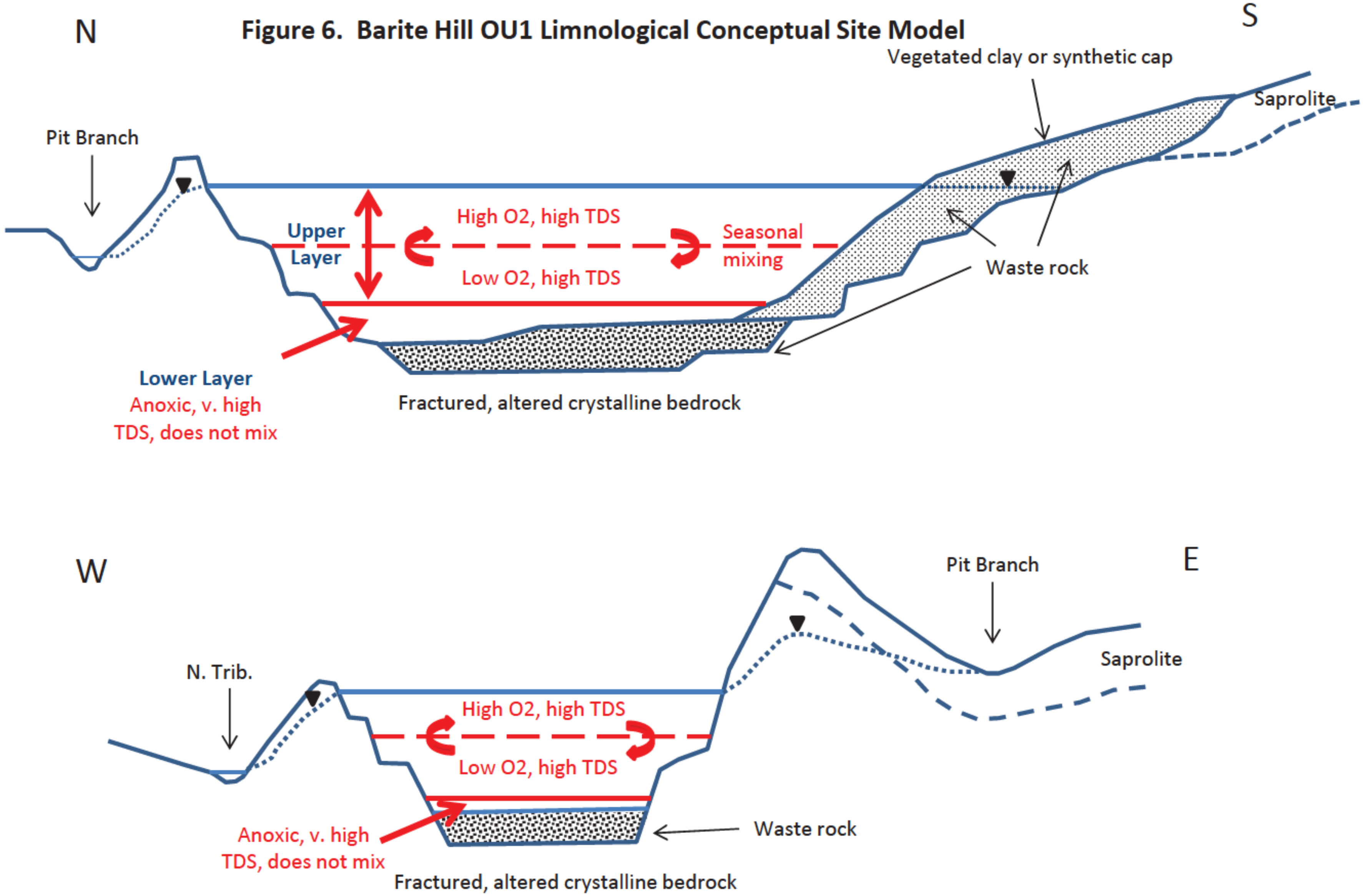


Figure 6. Barite Hill OU1 Limnological Conceptual Site Model



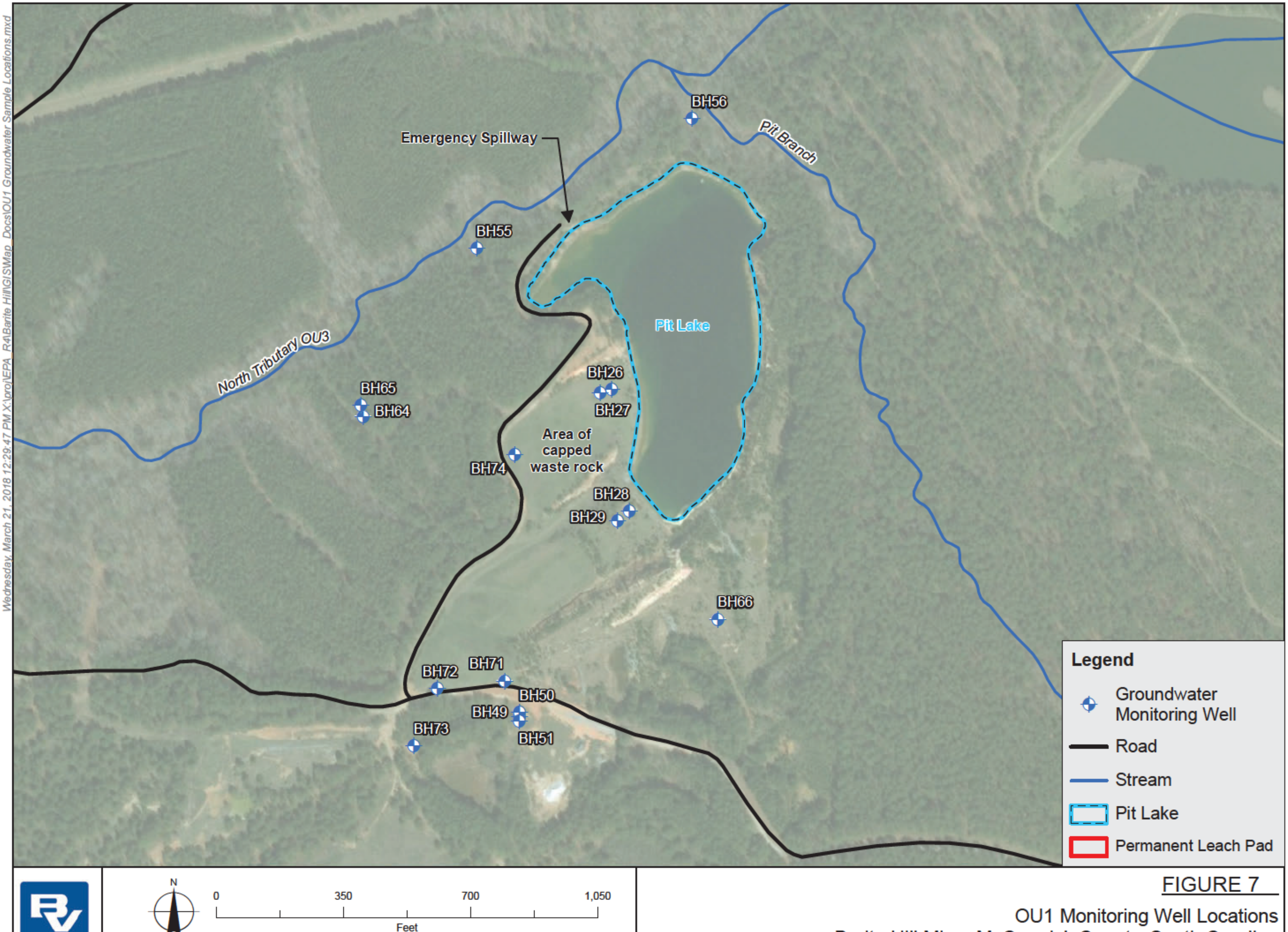


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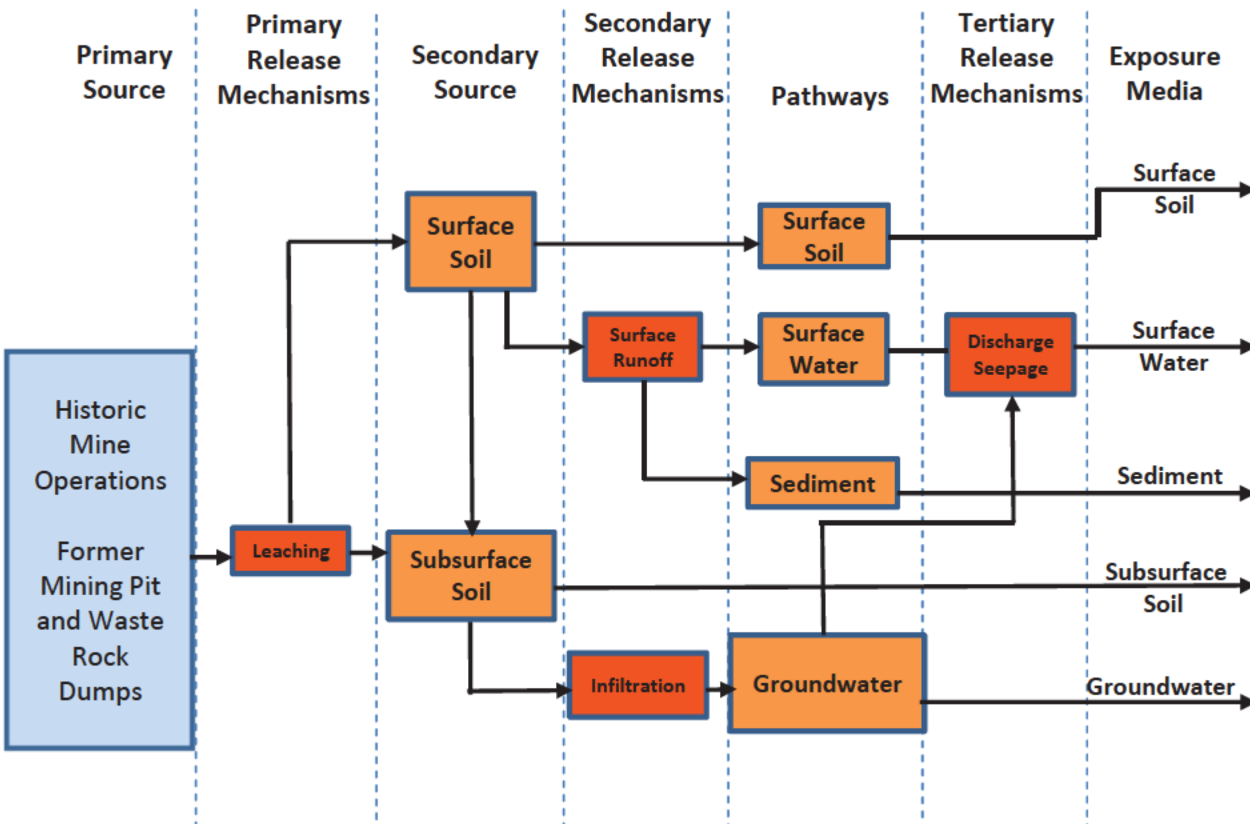
FIGURE 7

OU1 Monitoring Well Locations
Barite Hill Mine, McCormick County, South Carolina

Figure 8 HHRA Conceptual Site Model
Barite Hill Mine Site OU1
McCormick County
South Carolina



Potential Human Receptors

Exposure Route	Current Receptors: Trespasser / Recreational User	Future Receptors: Construction Worker	Future Receptors: Industrial/Commercial Worker	Future Receptors: Lifetime Resident (Child & Adult)	Future Receptors: Trespasser / Recreational User
Ingestion	●	●	●	●	●
Inhalation	●	●	●	●	●
Dermal Contact	●	●	●	●	●
Ingestion	●	●	●	●	●
Dermal Contact	●	●	●	●	●
Ingestion	●	●	●	●	●
Dermal Contact	●	●	●	●	●
Ing, Derm & Inh		o			
Ingestion		●	●	●	
Dermal Contact		●		●	

● Quantitative Evaluation
O Qualitative Evaluation

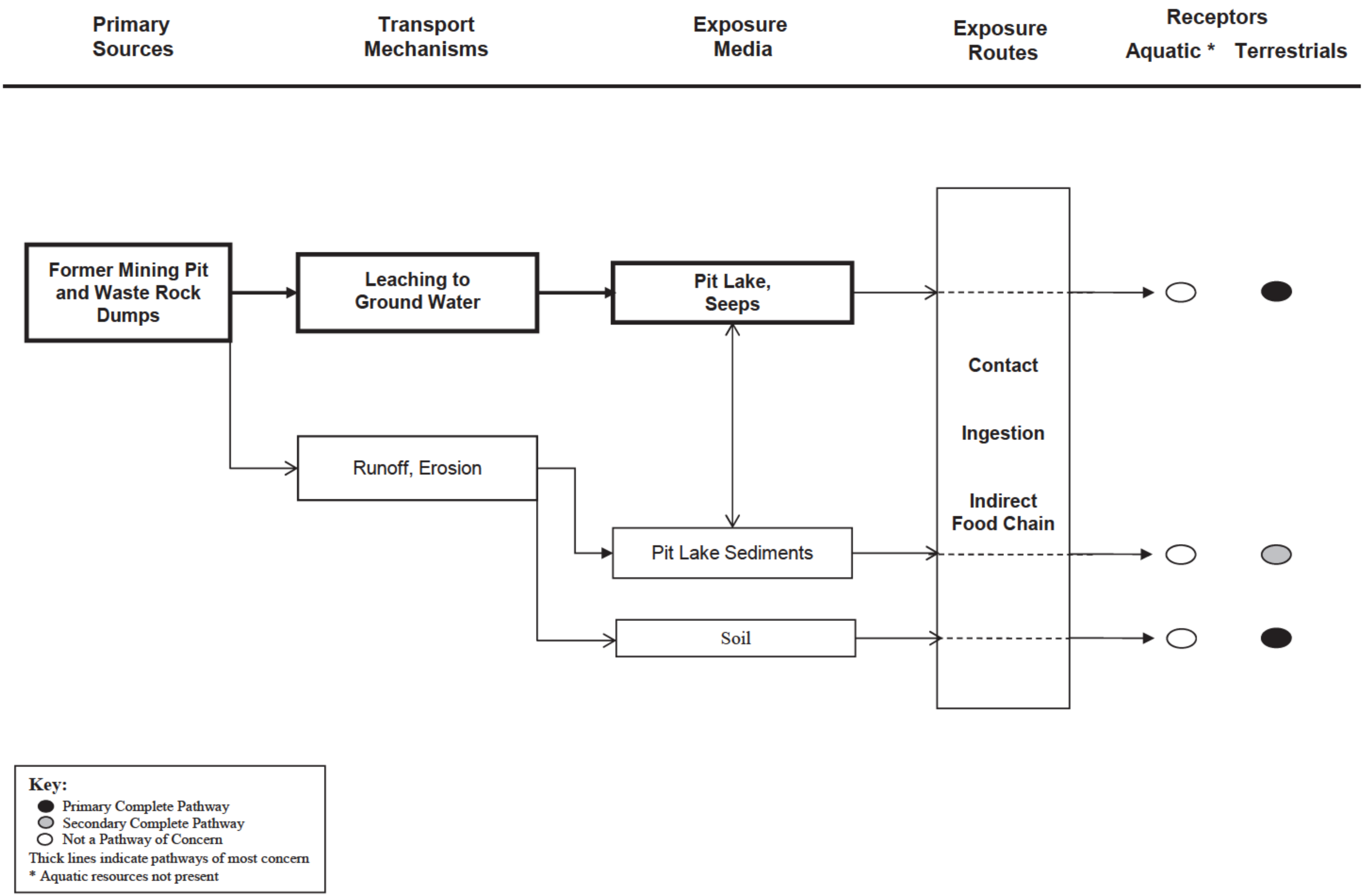


Figure 9
Ecological Conceptual Site Model for OU1

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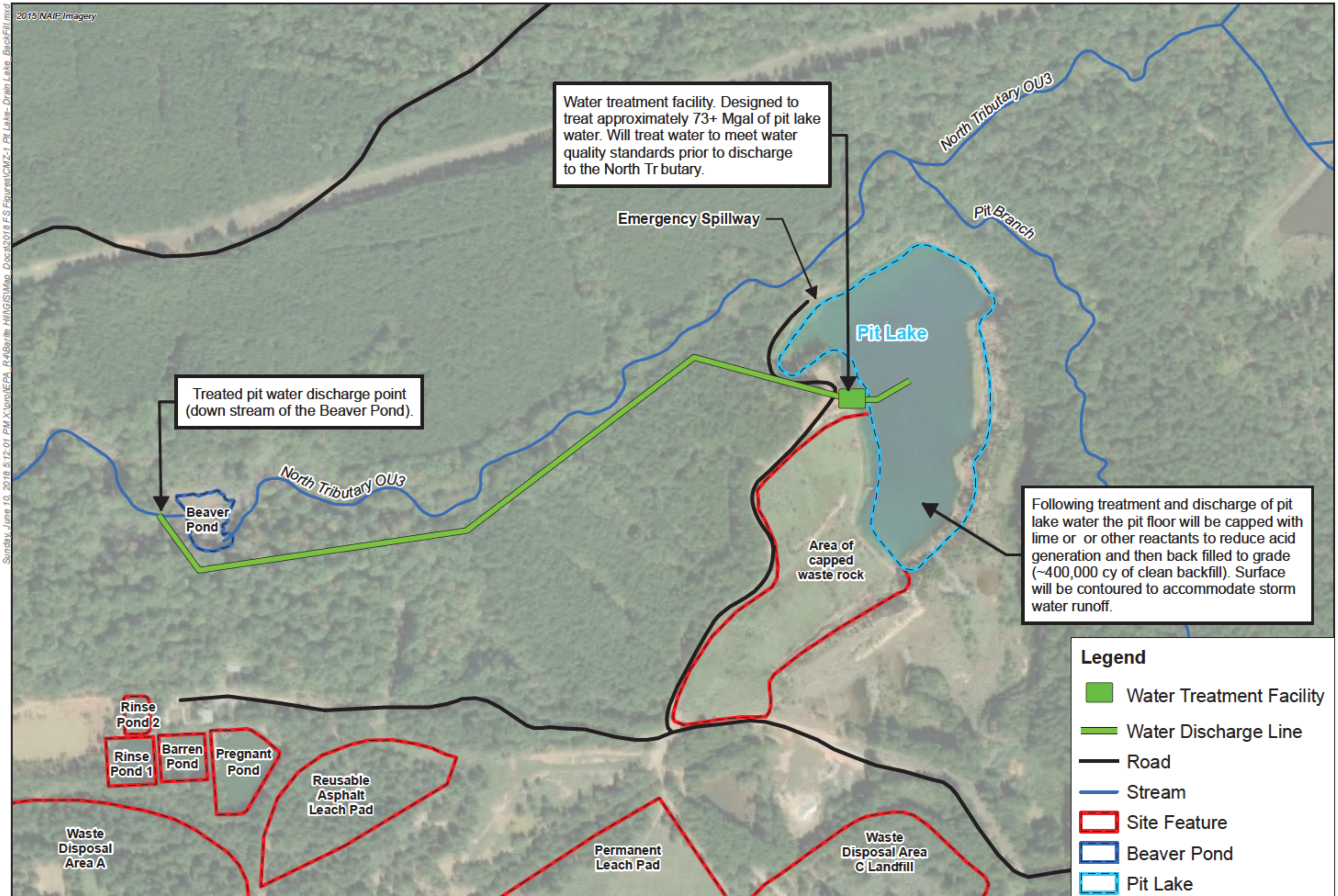

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FIGURE 10

CMZ-1 Pit Lake #2:

Drain Lake, Amendments to Pit Floor,Backfill

Barite Hill Mine, McCormick County, South Carolina

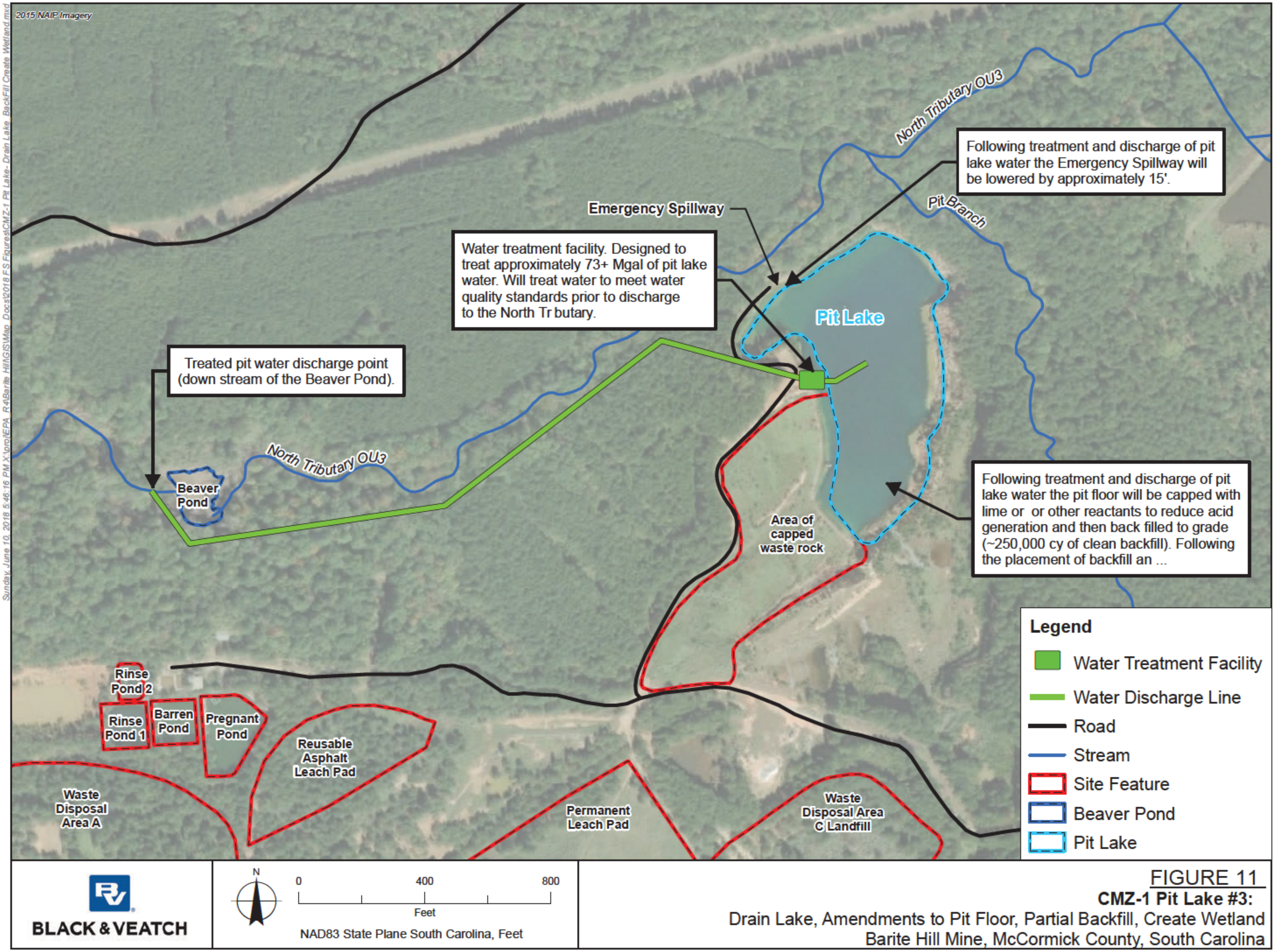

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FIGURE 11

CMZ-1 Pit Lake #3:

Drain Lake, Amendments to Pit Floor, Partial Backfill, Create Wetland

Barite Hill Mine, McCormick County, South Carolina

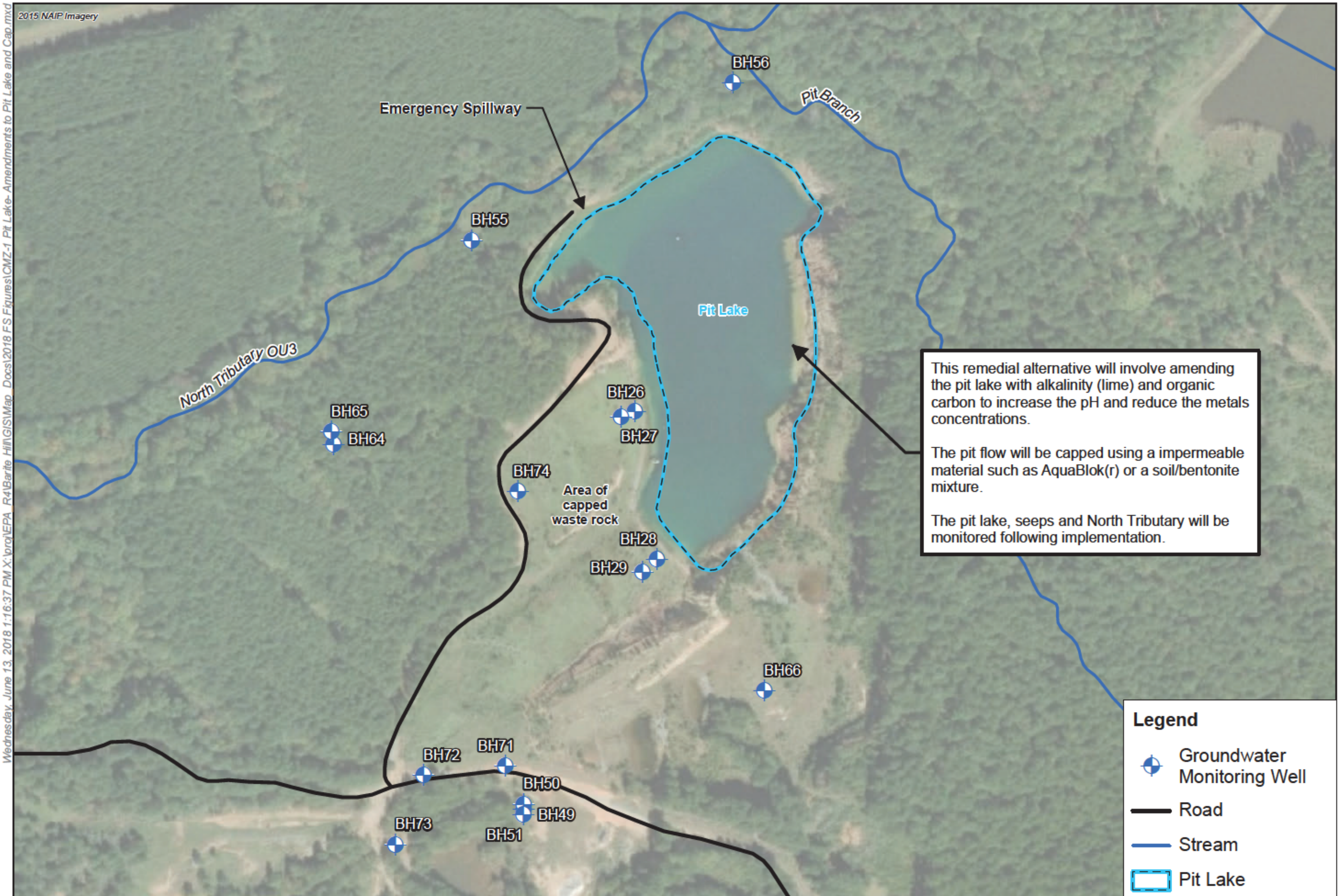

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FIGURE 12

CMZ-1 Pit Lake #4:

Amendments to Pit Lake and Cap Pit Floor

Barite Hill Mine, McCormick County, South Carolina

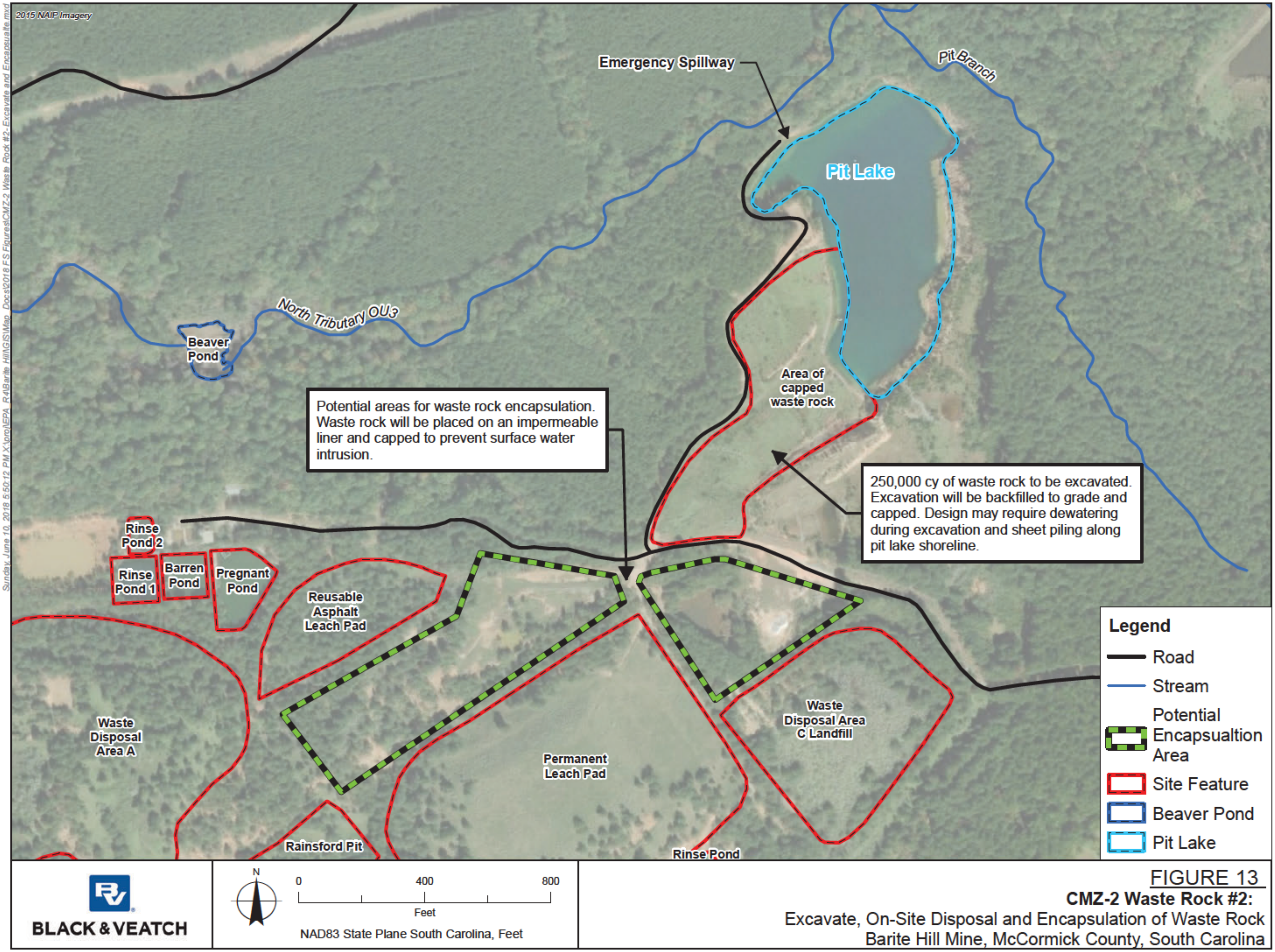
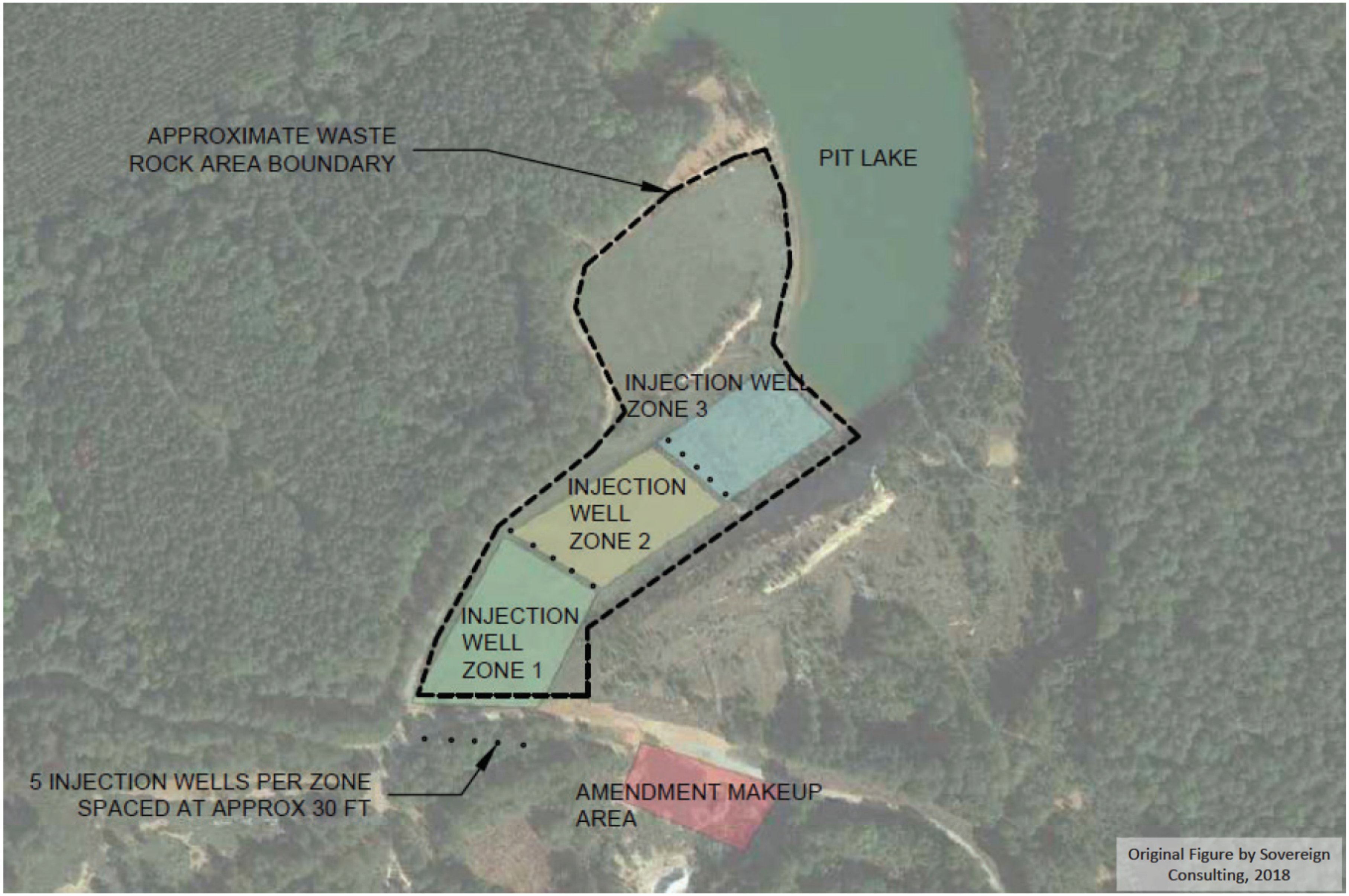


FIGURE 13

CMZ-2 Waste Rock #2:

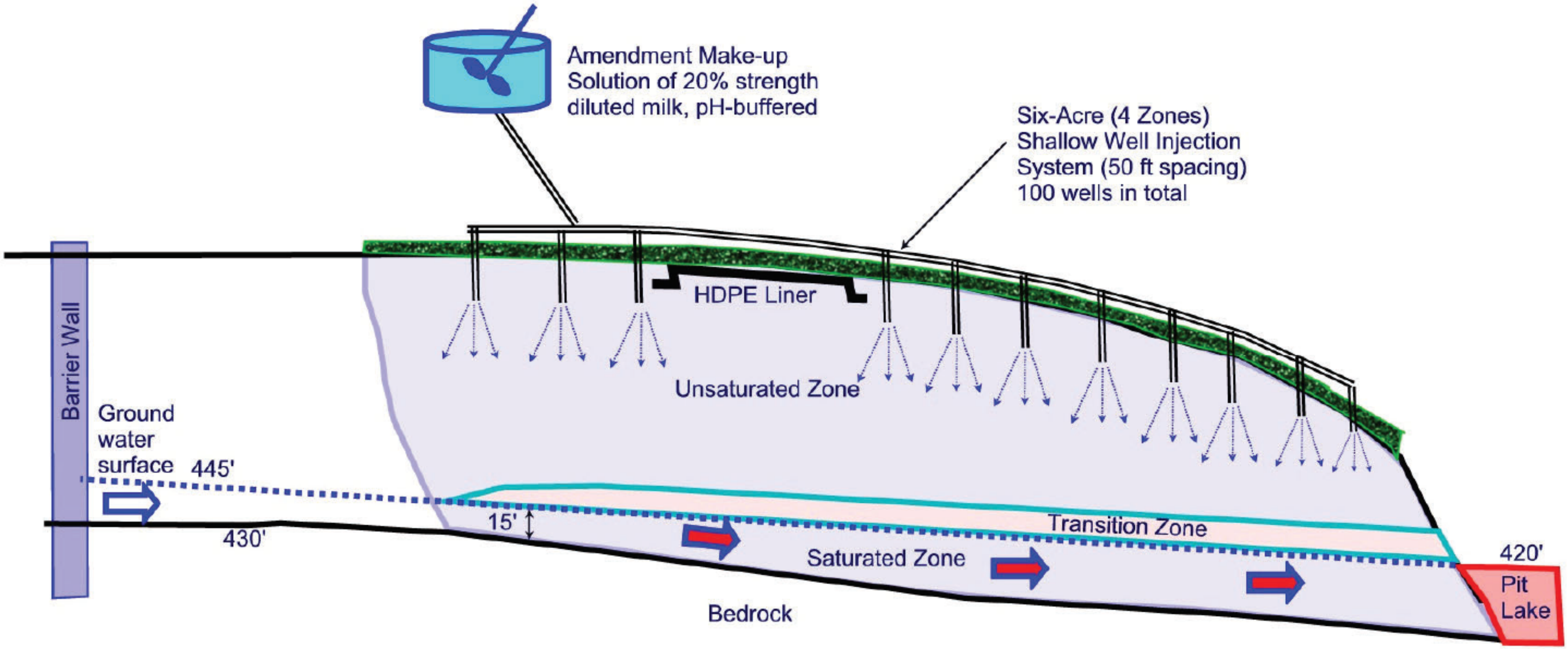
Excavate, On-Site Disposal and Encapsulation of Waste Rock

Barite Hill Mine, McCormick County, South Carolina



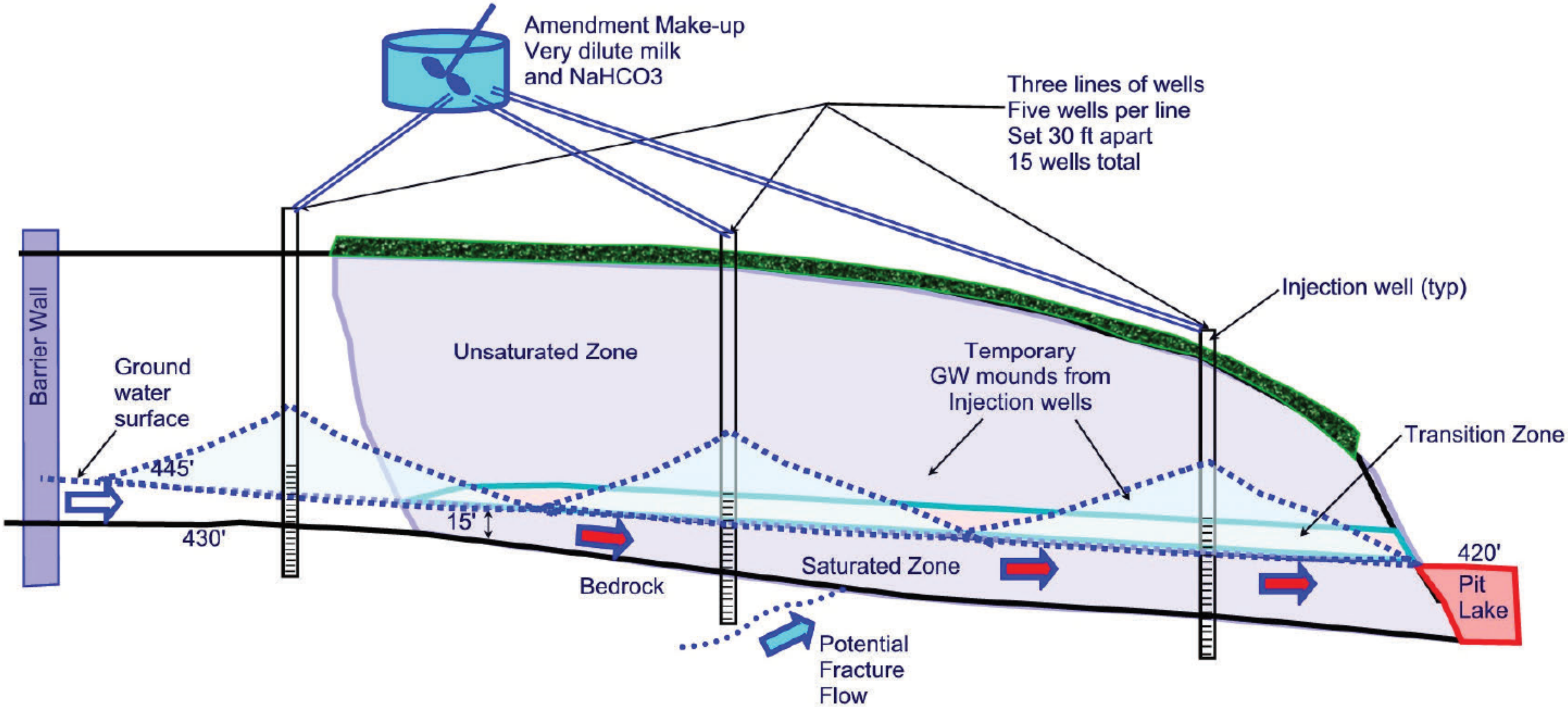
	Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Deep Injection Well Plan View	Figure 14

Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Shallow Injection Well Plan View	Figure 15



Original Figure by Sovereign Consulting, 2018

	Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Shallow Injection Well Schematic	Figure 16



Original Figure by Sovereign Consulting, 2018

	Barite Hill Goldfields Site McCormick County, South Carolina	CMZ-2, Waste Rock 3 Deep Injection Well Schematic	Figure 17

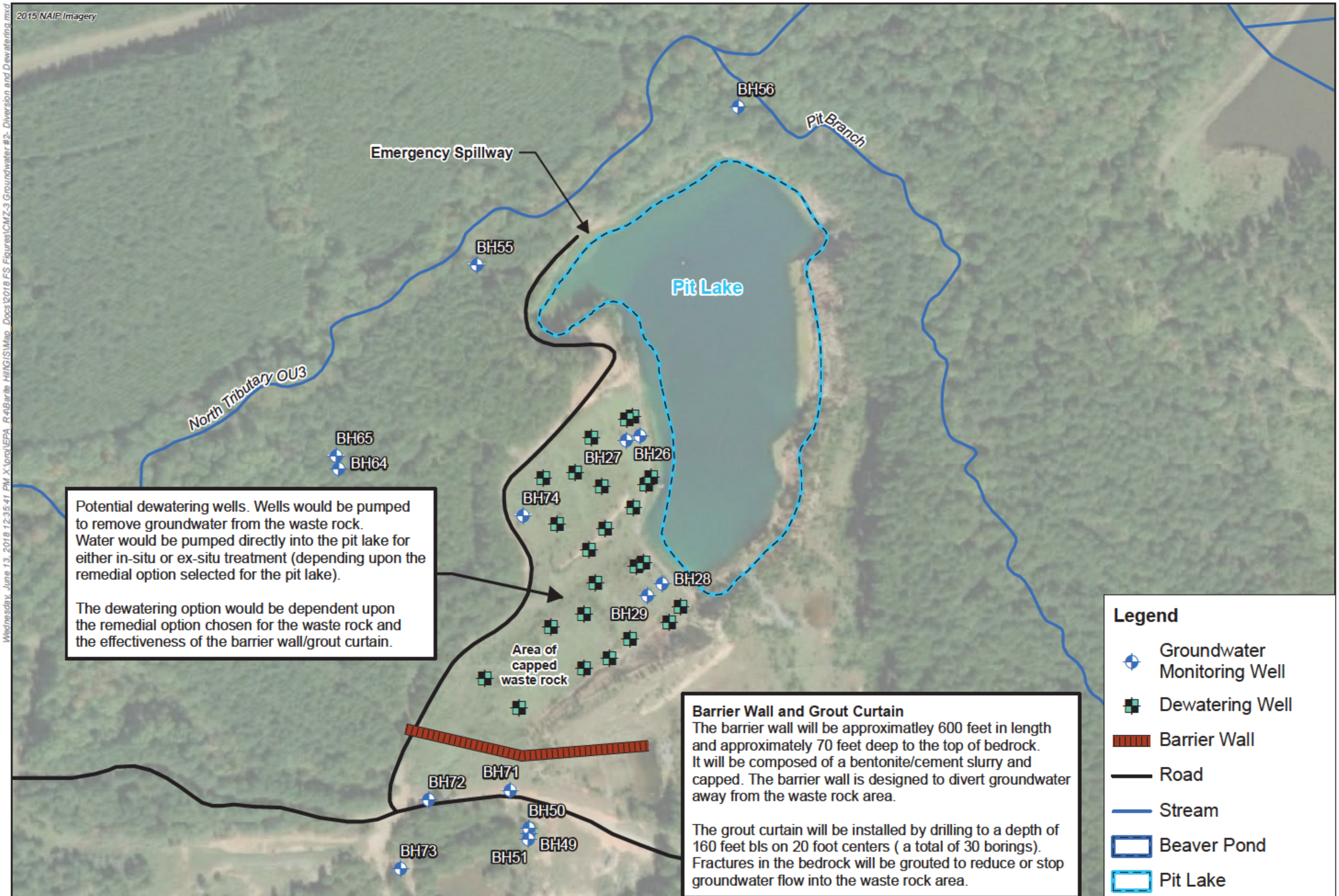


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FIGURE 18

CMZ-3 Groundwater #2A:

Groundwater Diversion and Dewatering of the Capped Waste Rock

Barite Hill Mine, McCormick County, South Carolina

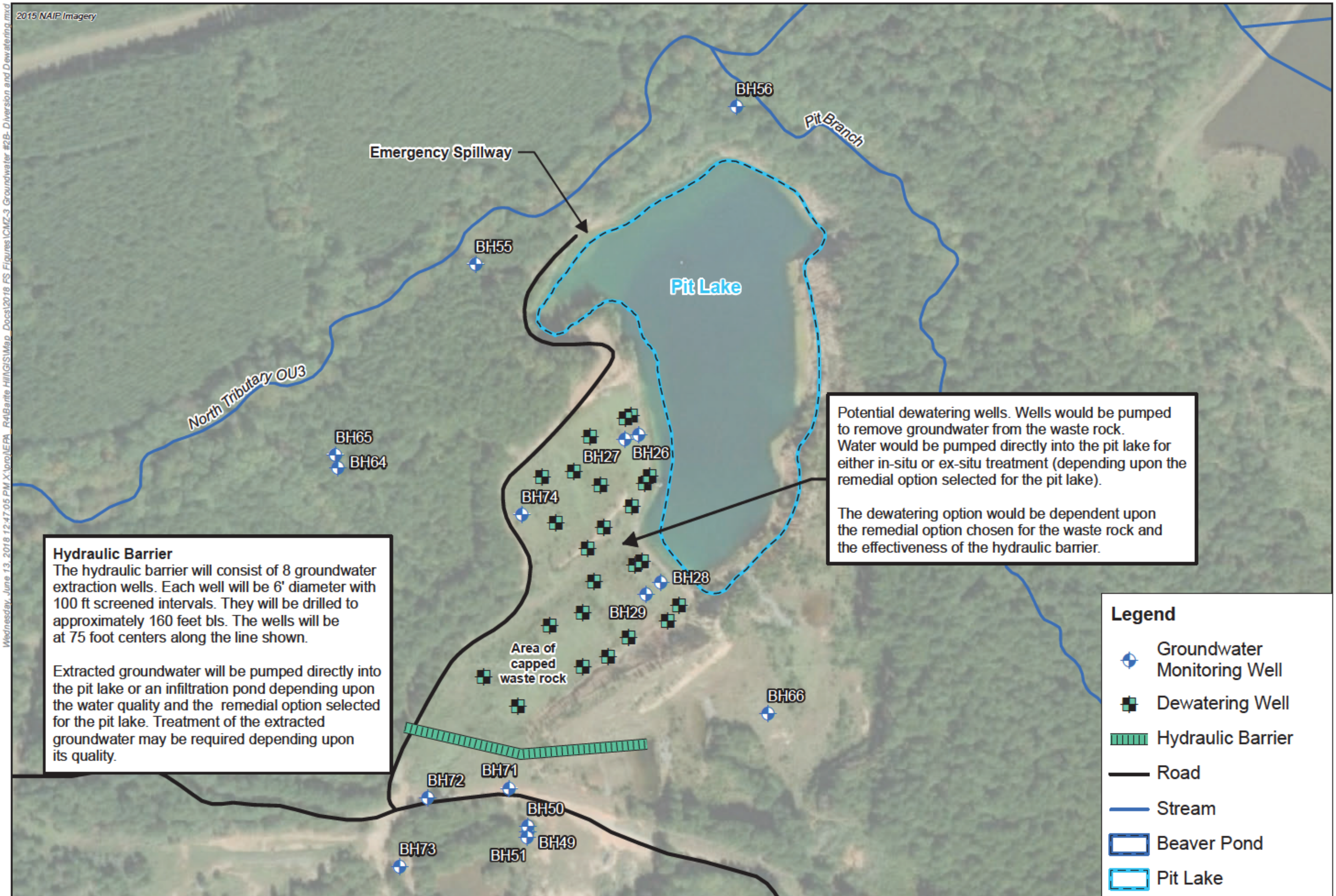

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FIGURE 19

CMZ-3 Groundwater #2B:

Groundwater Diversion Hydraulic Barrier

Barite Hill Mine, McCormick County, South Carolina

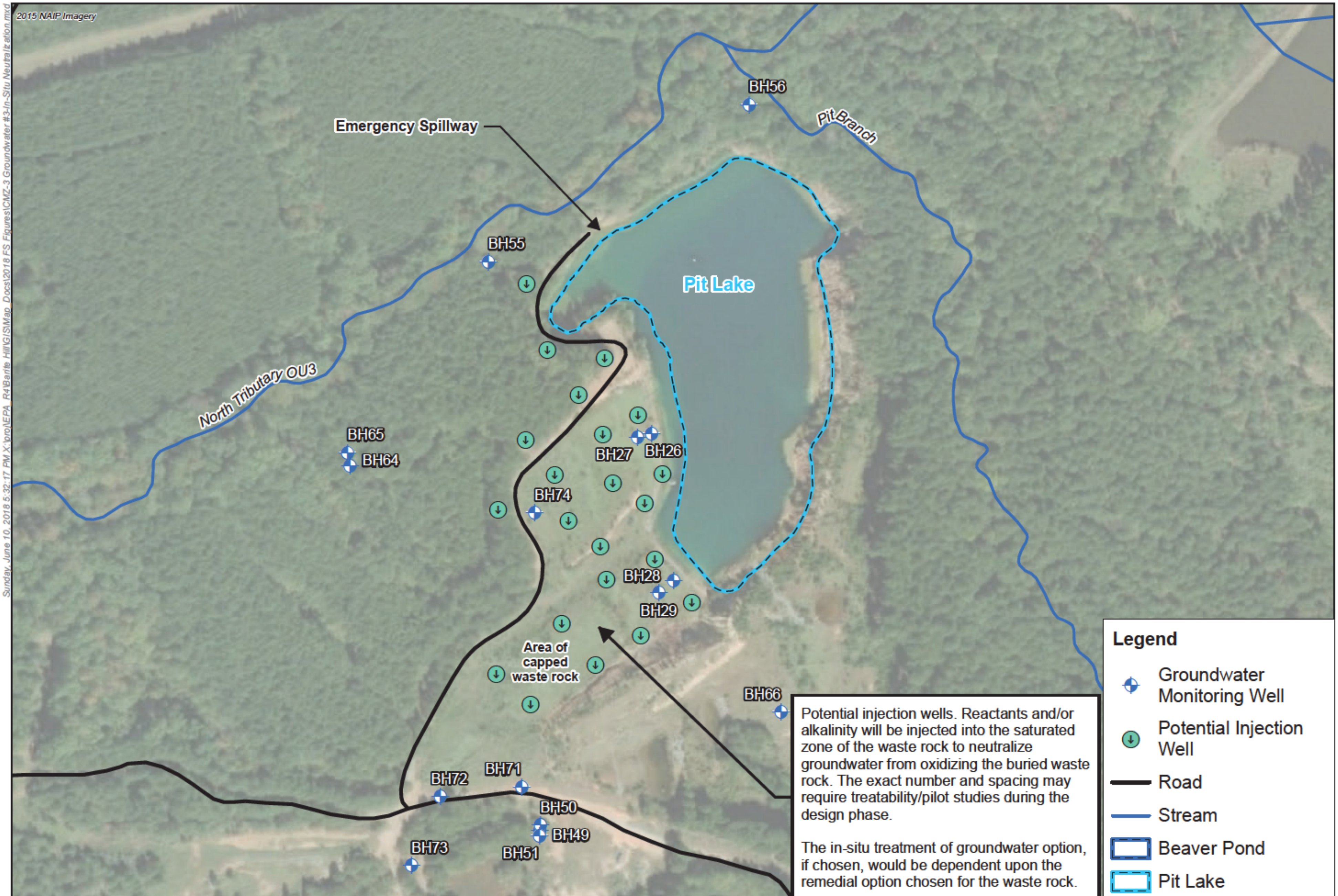

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FIGURE 20

CMZ-3 Groundwater #3:

Groundwater In-Situ Neutralization

Barite Hill Mine, McCormick County, South Carolina

APPENDIX A

TRANSCRIPT OF PUBLIC MEETING

BARITE HILL/NEVADA GOLDFIELDS SITE
PUBLIC MEETING

HELD ON
THURSDAY, MARCH 5, 2020
6:06 P.M.

MCCORMICK COUNTY ADMINISTRATION CENTER
601 SOUTH MINE STREET
MCCORMICK, SOUTH CAROLINA 29835

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PUBLIC HEARING FOR
BARITE HILL/NEVADA GOLDFIELDS SITE
HELD ON
THURSDAY, MARCH 5, 2020
6:06 P.M.

MS. ABENA MOORE: My name is Abena Moore. I'm the Community Involvement Coordinator with the Environmental Protection Agency, and I've been assigned to this site. So I just want to let you know who I am. I have a few other people here, a couple of other people here from EPA.

Mr. Nester Young; he's a section chief of the restoration and investigations section. This is Nester. And Candice Teichert; she is the Remedial Project Manager for this site.

All right. I have my little notes here because I've gotten older. I can't remember everything. So there are some other people here that I'd like for you to know that's here to answer questions if they need to.

The Department of Health and Environmental Control, they are here representing that agency. And the Commission of Public Works has a representative here in the back.

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Also, we have Ms. Charlotte Tallent, who is the Executive Director of the Chamber of Commerce. She's here. And Mr. Charles Cook, who is the Corporate Secretary for the company Savannah Lakes. Where are you? There he is. Savannah Lakes Village. Okay. Thank you. I?m happy to have all of you here.

So the purpose of this meeting tonight is to inform of you of EPA's plan to address the environmental impacts at the Barite Hill main pit lake system part of that site. Okay? Candice will be presenting that information. And during her presentation, if you could hold questions, that would help us get the information to you.

We will answer the questions after the presentation and if we don't have an answer, we'll make sure and get one for you. Also, if you we don't get to answer all your questions, we will stay a little bit after the meeting to address your questions.

If you haven't already done so, we encourage you to read the proposed plan that describes the cleanup that's chosen for this site -- or this plan of the site. We want your input on this remedy, which is why EPA provides a 30-day

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incumbent period to allow you to give us your comments. It started on February the 7th and it ends on March 8th.

I'm going to turn it over to Candice now to go ahead and get started.

MS. CANDICE TEICHERT: Good evening, everyone. So as Abena mentioned, this meeting is to discuss the proposed plan to clean up a portion of the site at Barite Hill here in McCormick. So a little bit of history about the site as you all know. Most of you are residents. The site is located here in McCormick, South Carolina. The mine has approximately 795 acres in total size and the area of concern that is affected is approximately 135.

And so the majority of that area was actually buffer. So the 135 is what we're really focused on. And so the area was mined from approximately 1991 to 1995. The PRP or the respons ble party attempted to reclaim or restore the area until 1999 before they abandoned the site and they literally handed the case to DHEC. And so EPA performed a removal action and a little bit of cleanup out there for the main pit between 2007 and 2008 as well as some waste rock dumps.

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And -- can you all see me okay? So this is the main pit right here. Okay? And these are the two waste rock dumps that I'm referring to. And so EPA then finalized the site on the National Priorities List in 2009. And we initiated the remedial investigation and feasibility sampling in 2011. So we started investigating and trying to characterize the contaminants at the site and the extent of contamination at the site in 2011.

And so we initially started working the entire site as one whole unit. And once we kind of understood a little more about it, then we decided to break it up into what are called operable units. So they're smaller areas that we are addressing individually.

And so operable unit 1, which is what we're addressing now, is the Barite Hill Main Pit Lake System. And so these are the operable units at the site.

So the first one is the Barite Hill Main Pit Lake System. Operable Unit 2 is the Overburden and Bedrock Groundwater. The 3rd one is the North Tributary to Hawe Creek, which I'm going to show you here in just a minute. The Southwest Tributary to Hawe Creek is operable unit 4. And then last, but

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not least, operable unit 5 is Hawe Creek.

So again, this is an overview of the site. Can you all see? So up here, this is operable unit 3. This includes operable unit 1, so this is the main pit lake area. This is the actual row, so all of this south to the south tributary is considered operable unit 4. And then Hawe Creek is operable unit 5. And of course operable unit 2 is groundwater.

And of course, these areas through here are operational areas for a new operating line, so of course you have a permanent leach pad, disposal areas, pregnant ponds. And these are all different process ponds.

So the Draft RI, remedial investigation report, was completed in 2017 for operable unit 1. And after the completion of that report, we discovered that we needed to collect some additional information based on the information that we had already collected. And so -- and we also realized that we needed to conduct treatability studies to evaluate source treatment areas and treating sources at the site.

And so the feasability study report was completed in April of 2019. And what we hope and

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anticipate is that the cleanup of operable unit 1 -- and I'm going to back up -- will actually help us clean operable unit 3. And I'm going to show you this in just a second.

But operable unit 1, so this main pit right here and this waste rock, we have fractures through here, which I'm going to show you, and we have seeps that go into the north tributary. And so we started investigating operable unit 3 first and we discovered that these two operable units were hydraulically connected. So we can't clean up the north tributary until we address this first.

And so the ROD for operable unit 3, the record of decision, will be deferred pending successful implementation of the remedy for operable unit 1. And so as I mentioned before, this main pit is hydraulically connected to this north tr butary right here, this creek. And so these are seeps that we've identified into that creek. And then geologically, these are fractures in fault zones that actually correspond with the seeps that we've identified and the locations.

And so this is actually a figure that is from the geophysical investigation that we conducted. And so you can see all the seeps, and you

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can also see groundwater flow and how it goes through and it kind of follows this fault zone through here, and it actually flows towards the pit and then out this way and as well as down that way.

And so for operable unit 1, we have three contaminated media zones at the site. So the first one is the pit lake surface water. So that is this pit lake and all of the water in that pit lake. So that's the first one. The second one are these waste rock dumps right here. And then the third one is the groundwater that's actually going through and into the waste rock and into the pit ultimately. So that's contaminated media zones 1, 2, and 3.

So this is what we're projecting to do. So in this figure right here, we're projecting to inject or insert a grout curtain or barrier wall to cut off and divert groundwater flow. So as you can see before, groundwater is actually flowing this direction into the waste rock and recharging and depositing contamination into the pit and then slipping out through fractures and seeps into the creek. And so we need to do something with this groundwater. So our plan right now is to divert this groundwater around this waste rock. So that's part of the plan.

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And this is a geochemical conceptual site model, so I don't want to confuse you. So we have waste rock right here, right, those waste rock dumps. And we have groundwater that's flowing through the waste rock and coming into contact with the waste rock and actually flowing into the pit as I mentioned and then out of the pit through seeps, through fractures, as well as through the spillway whenever it does overflow. And so this is what we're facing. In addition to that, we know that we have contamination down here as well actually in the pit, and so we're going to have to address this.

And that's part of the pit itself, right, it's operable -- or contaminated media zone 1. So this is a messy table. It's actually in the proposed plan. And this actually shows you all of your cancer and non-cancer concerns at the site and who is at risk. All right? So current/future industrial/commercial worker groundwater is really high. Right? And arsenic is the driver for carcinogenic risk and then these are the drivers for the non-cancer risk. So that's how we read that table.

ATTENDEE: Can I ask just a quick question? Are these going to be available so I don't

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have to frantically take notes or will we be able to get to these documents later?

MS. CANDICE TEICHERT: Absolutely.

ATTENDEE: Okay. Thank you.

MS. CANDICE TEICHERT: These are the COCs that we've identified, okay, so the contaminants of concern and remedial and objectives that we're working towards based on the risk. So the human health risk that's out there as well as the ecological risk. And so these are our remedial action objectives. So the first one is surface water and sediment in the pit lake. So as I mentioned before, we have contamination in the pit lake. All right? It's at the bottom.

And then we also have contaminated water that's in the pit lake. So our first objective is to minimize leaching from contaminated pit lake sediments to groundwater and surface water. The second one is to minimize benthic organism exposure, so that's organisms in the water column, to COCs in sediments exceeding levels protective of ecological risk. And then preventing exposure to COCs in surface water above protective levels.

This one right here is related to an exposure level that's exceeded for a trespass or a

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recreational scenario if someone were trespassing on site. The next one is groundwater, so we're -- our objective is to prevent or control the migration of contaminated groundwater to the pit lake and/or seeps that discharge to the north tributary. All right? So we want to clean that up and cut that off.

And then, of course, waste rock, right? Because that's our source that we're dealing with is to prevent exposure to ecological receptors in soils and then prevent or control migration of contaminants in soil or waste rock to groundwater. And so these are all the different remedial alternatives that we evaluated. So we evaluated a bunch of different ones for each contaminated media zone. So that's how they're separated.

So the first one is CMZ-1, CMZ-2, and CMZ-3. Again, the groundwater flow in the plan to insert a projected grout curtain or barrier wall. And so this is where we are proposing right now to put that barrier wall and grout curtain to cut that -- the groundwater off.

And we may have to -- so let's go back. So we may actually have to potentially try to de-water this as well. We don't know yet if we're

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going to have to de-water this, so that's what those walls are. And these are conceptual. So these are existing line areas. So remember whenever I mentioned before between 2007 and 2008, the EPA came out there and we actually did some treatment. So we actually halved these waste rock dumps and treated the water in the pit lake. And so this is actually liner that's existing over these half areas.

And so then this is the waste rock treatment. So the waste rock treatment, the treatability studies that we conducted out there, we conducted a number of different treatability studies. But in particular, for the unsaturated zone means that it's not saturated with water, right, or groundwater. We had come up with a dilute solution of mi k and what is the objective of that is to coat the waste rock so it prevents it from leaching.

And we did these studies and labs, and then these are the waste rock -- or I'm sorry, these are the treatment zones for injection wells. So let me go back here. So this is the shallow zone system right through here. And then we also have the deeper saturated zone that needs to be treated as well. And so after we installed the grout curtain,

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treated the waste rock, now it's to move on to the pit. All right? So after we diverted the groundwater from out there, we treated the waste rock in place successfully, the idea is to treat the pit lake.

And so we anticipate coating the waste that's in the bottom of the pit using a clay that we used at a number of sites. And it's a gravel -- it's actually gravel that's coated in clay. And that will hopefully prevent the back diffusion, is what we call it, of contaminants leaching into the surface water and water column. And so these are the remedial alternatives that we've selected, so we're capping the pit floor and ultimately we'll have to add amendments to the pit lake before we cap it, all right, because the water in the pit lake is nasty.

And then amendments to the waste rock, and then we're enhancing the existing cap and diverting groundwater around the waste rock. And so all told, it's about 22 million dollars. That's our estimate right now. And so this is the proposed remedial phasing. As I mentioned, grout curtain, waste rock, then on to the pit lake. And we are actually planning to phase the work.

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So thank you. Let me go back here. So we're planning to phase the work because we want to make sure that the grout curtain actually works before we move on to treating the waste rock. Because if we can't divert the groundwater around waste rock, then treating waste rock won't work. And so that is what we have and that is our proposed plan for operable unit 1.

Does anyone have any questions?

ATTENDEE: I have a question about the study that ended in 2017. How many people were involved in that and how much time did they actually spend with regards to that?

MS. CANDICE TEICHERT: So that was a long period of time, the remedial investigation.

ATTENDEE: Yes.

MS. CANDICE TEICHERT: So we spent a considerable amount of time. Our contractors actually performed --

ATTENDEE: So you had a contractor?

MS. CANDICE TEICHERT: Yes.

ATTENDEE: Where were they from?

MS. CANDICE TEICHERT: All over. Out West, some of them were out in Denver.

ATTENDEE: So they stayed here full time

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during that remedial study?

MS. CANDICE TEICHERT: Not -- not all the time, no. It was -- so it was while they were doing the work at the site. So if we were drilling or sampling and that sort of stuff, absolutely they would be there. Does that answer your question?

ATTENDEE: Not really.

MS. CANDICE TEICHERT: Oh, okay.

ATTENDEE: It didn't tell me how much time they spent here. Did they stay here six moths out of they year? Did they spend three months? How much time did they actually take to do that study?

MS. CANDICE TEICHERT: It took years. It took years.

ATTENDEE: But they weren't full time?

MS. CANDICE TEICHERT: Right. So it's based on funding and we -- and also based on, you know, as we collect data, where do we -- you know, how we move forward. And so that's the reason why it took so long. So we started that in -- I don't know exactly the date, but I can find out.

ATTENDEE: So did you start in 2011 and then the data was collected and put in in 2017? So you're looking at --

MS. CANDICE TEICHERT: Yeah, so it's not

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all the 2011 data. It's -- it's compiled over time. Yeah. So only the 2011 data that we collected. And I really kind of -- it made us decide whether or not we should divide the site into operable units and to separate it. So that's what it really did for us.

MR. NESTER YOUNG: Let me just say this was a very difficult and complex site. We've spent six or seven years studying it and there were many studies done, many contractors coming through collecting samples. And so here we are today to just address the pit system. And I don't think you can tell, but all those charts and graphs and --

ATTENDEE: I know where this is. I know exactly where this is.

MR. NESTER YOUNG: There are -- it's complicated. The site is complicated. To try to figure out where the water is coming from and where it's going.

ATTENDEE: Sure, sure.

MR. NESTER YOUNG: And so it took us a while to figure that out. And we spent millions of dollars, millions of dollars doing studies. And we're not done yet. This is only the first phase of this thing. We're not done yet.

ATTENDEE: When does the actual work

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begin?

MS. CANDICE TEICHERT: That's a great question. So just because we actually came up with a remedy, right, which is what we're proposing. We're saying hey, this is what we think will work. We then do what's called a remedial design, okay, so we design it. And like I said before, we're going to do it in stages. So the first stage is installing the grout curtain we'll use to divert the groundwater around.

And after we get finished with that remedial design, we're going to go to what is called a priority panel. And we have to compete for funding with other sites.

ATTENDEE: At what level is that priority panel? Is that in Washington, D.C.?

MS. CANDICE TEICHERT: It is.

MR. NESTER YOUNG: It is.

ATTENDEE: And it's made up of people only from the EPA?

MR. NESTER YOUNG: Correct.

MS. CANDICE TEICHERT: Correct.

ATTENDEE: Okay. So you're ta king about top-level EPA?

MS. CANDICE TEICHERT: Yes. And we're

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competing with other sites.

ATTENDEE: How many are of this level of - -

MR. NESTER YOUNG: That's a very interesting question. You're kind of hitting at the heart of it. So we at -- you know, as Candice mentioned, after we completed the design unit, now we have something that we know what we're going to construct and how much it's going to cost.

We have to go to Washington, D.C. at EPA headquarters and say okay, this is our plan, this is how much it's going to cost, will you give us the money. And so they go through a ranking process. They look at all the sites that are ready to be funded and they rank them in a matter of priority. So the answer to your question is this site is an ecological risk. Okay? There aren't any -- there is nobody exposed to it at the moment. And so we are competing with other sites around the country that have human exposure. And so those sites get priority because people are being exposed to those sites. This one isn't.

ATTENDEE: How many are there right now that's competing?

MR. NESTER YOUNG: There's about, I want

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to say, 50 or 60 sites in the queue that have not been funded. Just to give you an example, I'm dealing with another site here in the state called Brewer Gold. We took that site about six or seven years ago to the priority panel and still haven't received funding. We have a design for that site and it's been in the queue. That site is very similar to this. It's an ecological risk. There's not a human health component to it. They haven't funded it yet.

MS. CANDICE TEICHERT: So and the ranking, I mean, really Nester, I think, is addressing it very well. So if you have people who are exposed, right, and they're drinking contaminated water or their kids are exposed to contaminated soil, those are the sites that are going to get funding first.

ATTENDEE: Well, with it not -- draining into Hawe Creek? Would that not be an ecological problem?

MS. CANDICE TEICHERT: So it is ecological, but it's not human health.

ATTENDEE: Because that's where our drinking water comes from for the town.

MS. CANDICE TEICHERT: So we don't have any data to suggest that your drinking water has

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been impacted by this site.

MR. CHARLES COOK: But a lack of data is not data indicating that there is no problem.

MR. ADAM HEDDEN: One thing I can kind of address with you the intake for our water in the town is way upstream of where that -- I say upstream. (Inaudible) And where this is coming in from Hawe Creek is a good ways. It would have to almost go upstream against the undercurrents of the lake to get back up to that. So where we're getting water from is in good shape. I have actually called DHEC and asked if we've had any traces and that kind of stuff, and we have not had any of those show up in our annual study test as of yet and I don't anticipate us having any based on what I --

MR. CHARLES COOK: But that does not mean -- and I respect Adam in terms of being able to provide a clean and pure water supply to the town of McCormick and the county, which derives much of its water supply from CPW. But if you have heavy metals draining into our creek, even though they're not necessarily getting into the water supply, they could certainly be impacting fish, the water foul, small mammals, and other animals that are downstream of that. This is a major recreation area of both

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fishing and hunting.

And if you're not taking samples of fish, water foul, small mammals, deer, you can't -- just because there is no data to support this does not mean that those heavy metals are not getting into the food supply. If you have -- if you have water seepage into well water and there -- most of this county is not on either the City or County water supply. They're getting their water from wells. They're irrigating their soils from wells. They're irrigating their gardens from wells. They're watering their livestock from wells.

It seems to us that there needs to be far more testing done with respect to potential impact of what's already come out of this site and what the potential is for success of all of these measures to maintain it outside of the immediate environment. We prepared a list of about 20 questions with respect to that. I'm not going to discuss them all tonight, but we think there are serious enough questions and issues that are involved, not only in terms of what is the l kelihood of success of this, whether or not there has been -- there have been environmental impacts.

Over the years since Nevada Gold Fields

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has left this place, what is going to be the economic impact on the county, which could be from several. If you're going to -- if you're going to spend 21.9 million dollars in this county or at least some significant part of that, are you going to have contractors coming in seeking accommodations and places to stay, how long are they going to be here, are they going to be coming in and out. Is there -- are they going to require local labor. Are they going to require local labor of a particular skill.

We understand that it may not happen overnight. But this is -- this is a project that's going to -- as you said, it's very complicated. It's going to require a significant collaborative process with local agencies. You might have to involve the Corp of Engineers, Department of Natural Resources, the State Parks and Recreation Department, the Forest Service. I mean, there are all kinds of potential impacts that will have to be coordinated.

And we'd like a little bit more information so that the town and county and all of these organizations can come together and supply it. So as a result of that, we would -- we would like to

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request and we will be sending this along before the deadline. We would like to request that the deadline for comments be extended until additional information can be provided that can be discussed with the public and that the public can be a little bit more informed with respect to what the project is all about and what the long-term implications are before that comment period ceases.

(Multiple speakers talking simultaneously.)

MR. CHARLES COOK: I understand. I think these are -- I think these are real, significant questions that need to be answered before the public can actually form an opinion as to whether or not -- what the chance of success is, whether or not there are already environmental impacts that have not -- have not yet been documented for which some kind of remediation is required. And how long this process is going to have to continue to make sure that after you all complete this project and leave that this is sufficiently monitored to make sure one, that it works --

MS. CANDICE TEICHERT: Yeah --

MR. CHARLES COOK: -- and two, that there are sufficient funds available on a long-term basis

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to do the testing and monitoring that are required to ensure that.

MS. CANDICE TEICHERT: So let's go back here. So you mentioned about -- you know, we were talking about phasing, right? So to make sure that each phase of our remedy is successful. And so we're just as concerned as you are, right, as far as not wanting to select something that fails. Right? I mean, we're not -- we don't want to spend 22 million dollars and it not work. So ensuring that the grout curtain is actually working is the first step, right, in making sure through monitoring and testing that that's working, right, and that we've diverted groundwater around. And that's extremely important. You mentioned private wells. So we actually conducted well sampling. That was one of the first things we did. And we have not had any indications that any other wells are contaminated around that area from this site.

ATTENDEE: That was my question. I've got 28 acres right across the dirt road from the site. Are y'all checking that well water? Because I've got children and grandchildren that's coming to play in that water and maybe drinking that water. Is it safe?

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MS. CANDICE TEICHERT: Yeah, so we've checked all of those wells in the area. That was the very first thing we did.

ATTENDEE: Well, yeah, but that's been several years ago, right?

MS. CANDICE TEICHERT: It was, yeah.

ATTENDEE: Have y'all been back to do it?

MS. CANDICE TEICHERT: I don't know specifically. Shumpert, right?

ATTENDEE: Right.

MS. CANDICE TEICHERT: I don't know specifically. I think we tested it at least once to make sure --

ATTENDEE: That's the one I had done and I had the people here to come out and check it because that was my major concern. And they told me well, pour a couple of gallons of bleach down there and it will correct the problem. So how long (inaudible due to laughter in the audience.)

MS. CANDICE TEICHERT: Well --

ATTENDEE: That scares me with my kids out there playing in this water or drinking this water, is it safe.

MS. CANDICE TEICHERT: So I completely understand. So we were talking about groundwater direction and groundwater flow. So in relationship to your residence, right, the source of contamination at the site is this waste rock area that we know about right here for this particular operable unit. And so the groundwater flow is actually not towards those residents. And you also need to consider a buffer zone, the buffer area. And so we've sampled and we have no reason to be concerned.

ATTENDEE: Well, I knew y'all came when you first --

MS. CANDICE TEICHERT: Yeah.

ATTENDEE: But I haven't seen anybody else come back and say can I get some sample of your water, we're going to test it and make sure it's okay.

MS. CANDICE TEICHERT: Right.

MR. CHARLES COOK: But the other -- the other -- the other thing is if you have consultants who come in and do testing with respect to water flows, it depends on the weather and the environmental conditions when they do that testing. If they come in in a condition of drought, which existed I think to some degree in the 2011/2012 time frame, versus when we have higher than -- of water

in Lake Thurmond. We've had practically three straight months of rain. Water flows that consultants measured at that time may have absolutely nothing whatsoever to do with the -- with the water flows that are occurring now.

MS. CANDICE TEICHERT: So groundwater, it depends on the geology. But groundwater is different from surface water. So if you mentioned it rained considerably, right? So the geology here, I mean, is significant.

MR. CHARLES COOK: Well, let's take for an example, though, if you've got -- if you've got contaminants in a major mine pit, during a period of drought, there is very little that's leaching -- that may be leaching out of that. If you have --

MS. CANDICE TEICHERT: You're talking about this main pit?

MR. CHARLES COOK: Yes. If you have the kind of rain that we've had, I mean, the water level of Lake Thurmond is up over ten feet. Now, that obviously has had some impact with respect to the water that's in that pit. Now, if that is -- if that is flowing out, I mean, you've got water that's seeping into the water table, but if you've got water that's seeping out, whether it's going into

Hawe Creek, whether it's going into the soil, or whatever, then you have significant potential for those heavy metals to be spread and to contaminate the surrounding area.

MS. CANDICE TEICHERT: Yeah, and so that's -- okay. So we know that we do have sediment contamination from an ecological perspective, ecological risk in the north tr butary. So we know that. But we know that we can't fix that until we fix this.

MR. CHARLES COOK: I understand.

MS. CANDICE TEICHERT: Yeah.

MR. CHARLES COOK: Our major concern in the long run is -- as you can -- I worked in Washington, D.C. for over 30 years in the U.S. Department of Agriculture I know how funding decisions get made on a priority basis for particular projects to come forward with the funding. You proposed a solution. We support the solution. What we want to make sure of is that it happens. And that the monitoring and testing that have to be done to make sure that it works --

MS. CANDICE TEICHERT: Yes.

MR. CHARLES COOK: -- continues over an extended period of time.

MS. CANDICE TEICHERT: Absolutely. So that's included. So even after we're finished with all these phases, so the grout curtain, the treatment of the waste rock, and the pit, we are still going to monitor this tr butary to ensure that everything is working because we actually have points of compliance, right, and discharge monitoring -- so we can't --

MR. CHARLES COOK: You've done studies in 2011. Now it's 2020.

MS. CANDICE TEICHERT: So in 20 -- no -- weve -- we've been doing studies all along.

MR. NESTER YOUNG: We've been doing studies all along.

MR. CHARLES COOK: I understand.

MS. CANDICE TEICHERT: Yeah, all along.

MR. CHARLES COOK: I understand.

MS. CANDICE TEICHERT: Yeah.

MR. CHARLES COOK: But, I mean, once -- once the -- once the major work has been done, we want -- we want some insurances that you're just not going to go away.

MR. NESTER YOUNG: That's why the State's here. After -- (multiple speakers talking simultaneously) -- the State's going to take over.

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MR. CHARLES COOK: That goes back to the issue that I mentioned, that this is a major collaborative effort between a number of state and federal agencies and we want to make sure that we have sufficient information on hand in order to plan those -- those -- the establishment of those collaborative relationships to make sure that everything's going to work.
MS. CANDICE TEICHERT: We agree. Yeah.
ATTENDEE: Well, my bottom line is should I be checking my well two or three times in a year to see the safety of it? Or would y'all -- would y'all do it to make sure it's safe? Cause I live right across the road.
MS. CANDICE TEICHERT: So, I mean, absolutely. I mean we --
MR. NESTER YOUNG: We can come out and check it again.
MS. CANDICE TEICHERT: We can.
MR. NESTER YOUNG: If that's your concern.
ATTENDEE: It is.
MR. NESTER YOUNG: But the types of contaminants that we're talking about here don't travel very well. If we?re talking about organics, then I would have a little bit more concern. But

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we're talking about metals essentially. And one of the other things that?s wrong with this thing is the pH level of the water. So I wouldn't be so concerned about your well based on the types of contaminants, where the contaminants are in relation to your well. There's not much of a connection there. We can go out there and take a sample just to be sure.
ATTENDEE: I'm just asking because my grandchildren play in it.
MR. NESTER YOUNG: Sure, and I understand. And I would be concerned too.
MS. CANDICE TEICHERT: Yeah. We can.
MR. NESTER YOUNG: So since we haven't been out there in a while, we can go out and take another sample just to check it.
MS. CANDICE TEICHERT: Sure.
MR. CHARLES COOK: I would just -- I would just comment that if you're ta king -- particularly you're talking about heavy metals. If the well is full and you do the test, it's -- it's highly unl kely that you're going to find significant contamination. If there's drought and as the water level goes down and if people are irrigating out of those wells and the pipes that go down, they're

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drawing water out of those wells, are much more likely to be drawing heavy metals out of the -- out of the bottom of that well than they are when that well is full. So I understand you need to test in significantly different conditions.
MR. NESTER YOUNG: So do you know how deep your well is?
ATTENDEE: We don't -- we've got City water. But we've got well water that --
MR. NESTER YOUNG: Right. So how deep is your well water or your well?
ATTENDEE: Oh, it's deep. I --
MR. NESTER YOUNG: Probably several hundred feet?
ATTENDEE: When we -- when we pull the pipe out, it stretches across the pasture. So it's a deep well.
MR. NESTER YOUNG: Yeah. So that's another plus because these contaminants aren't deep. This is all shallow stuff. So if your well is 20 feet deep, maybe there is a concern. But if your well is 100, 200, 300 feet deep --
ATTENDEE: I just wanted peace of mind. That's why I brought it up.
MR. NESTER YOUNG: Yeah.

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ATTENDEE: If y'all couldn't do it for me, then I'm going to request the town to come do it for me.
MR. NESTER YOUNG: We'll take over on the samples.
MS. CANDICE TEICHERT: We can do it, yes. We can do it.
MR. CHARLES COOK: I want to -- I want to raise -- I want to raise one more issue because it's very important to us at Savannah Lakes Village. We're -- we've got 4,000 acres, 5,000 lots. We're about one-fifth to one-quarter built out. There was an article that appeared -- it was an AP piece that appeared in the index journal. It indicated that there was a release out of this -- out of this pit of something like 455,000 gallons a day. Okay?
MS. CANDICE TEICHERT: So we're aware of the article.
MR. CHARLES COOK: We tried -- we tried to verify it, have somebody comment on it. It has gone all over the country. It has probably had adverse impact on our ability to recruit people to come to McCormick, South Carolina because of -- I mean, this is the fifth -- this was the fifth ranked -- highest ranked discharge in the nation. And what we'd like

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to know is whether or not that report was true. If it wasn't -- if it was true, where did the information come from. If it wasn't true, has it been denied or repudiated in the media or in any type of public source that -- that we can use. And if it hasn't been, why not.

MS. CANDICE TEICHERT: Those are a lot of questions. So we have -- we have searched through all of our records, and we have no idea how they came up with that, that calculation. We don't know -- we don't know --

ATTENDEE: Who wrote the article?

MR. NESTER YOUNG: Well, it was an AP article.

MS. CANDICE TEICHERT: It was an AP article. We don't know. Yeah, so we've searched through all of our records, and we don't know how they calculated that, who -- where they got their information from. We don't know any of that. We, to my knowledge -- Nester, you may know differently -- we have not repudiated that. Are you aware of -- I don't think we have.

MR. NESTER YOUNG: No. Generally speaking, the EPA doesn't do that when there is a bad article written.

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MR. CHARLES COOK: Thanks. I understand.

MR. NESTER YOUNG: They generally don't.

ATTENDEE: But I'm just -- I'm just saying when you've been -- when you've been castigated in the press and the information is attributed to coming from EPA, then I think EPA has a responsibility if that information is not true --

MR. NESTER YOUNG: Trust me, I absolutely agree with you. But in this particular case, we had no control over it. That was -- that was the AP reporter that dealt with somebody at headquarters.

MS. CANDICE TEICHERT: And, you know, my counterpart here, Joel and I, we -- we've searched through everything trying to figure out how they calculated that, and we can't come up with anything.

MR. JOEL PADGETT: The best -- to our knowledge, that the remedial investigation has a section in there where they actually measured some of the seeps and it came -- their calculation is - - came out with between 4,000 and 13,000 gallons per day in that region, in the northern tributary that goes to the property. So it says quite a bit less than the AP report.

ATTENDEE: I have a question. Other than the Lewises here, do you know how many other

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households are being really a -- I don't want to say households that are being watched or that are considered in the danger or the -- that could be poss bly affected? Do we know how many that there are?

MS. CANDICE TEICHERT: So what we did is we performed a water use survey early on. I don't remember the exact date. I think it was in 2011. And so we performed a water use survey because initially the information that we had is that everyone was on City water.

And whenever I -- so whenever we started driving around, it was clear to us that that was not the case. You could see wells and well houses. So we performed a water use survey, and we sampled wells along Jefferson and Greenfield. And I don't know the exact radius. I'll have to get back to you on that, but we have sampled a number of wells along those two -- those two areas and those two roads.

MR. CHARLES COOK: I think you'll find that's quite common, though, to have for the -- that have City water supply to the house, but to irrigate, water the animals, and water the gardens and so forth with well water.

MS. CANDICE TEICHERT: Yeah, and so we did

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have concerns that people may be drinking, you know, contaminated water, so that was one of the first things that we did was to make sure.

MR. NESTER YOUNG: And we found nothing.

MS. CANDICE TEICHERT: Right.

MR. NESTER YOUNG: We didn't find any -- any concerns.

MS. CANDICE TEICHERT: Right.

ATTENDEE: I have another question. So say your plans work and you're able to clean this site up. It's sitting on 800 acres, which could be a potential new development to this area from maybe an economic standpoint.

MR. NESTER YOUNG: That's a very good question actually.

MS. CANDICE TEICHERT: Yeah.

MR. NESTER YOUNG: Yeah, so are you asking will eventually that -- that land be turned over to some productive use?

ATTENDEE: Yes.

MR. NESTER YOUNG: Yes, absolutely. Absolutely. The EPA is all about reuse.

MS. CANDICE TEICHERT: Right.

ATTENDEE: Who owns it?

MS. CANDICE TEICHERT: So that's a complex

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answer. So essentially the property owner is the Nevada Gold Fields, which is no longer a business. So they abandoned it, they filed bankruptcy. And so I guess it's in limbo essentially is what it is.

And so the state -- the state has not accepted it. All right? And it hasn't been auctioned off for back taxes. So it's kind of -- the company that is no longer around essentially owns it and we're attempting to clean it up, so. And so this is -- we're going to be here for a while. I don't want to be discouraging, but this is one piece of this site. And so --

MR. NESTER YOUNG: We've got all those areas in red to clean up.

MS. CANDICE TEICHERT: Yeah. So, you know, this is -- I mean, including these tributaries -- and so how we're planning to work this is this is going to be the next one that we're working on. So everything south of this line and this tributary will be next as far as investigation. And then lastly will be Hawe Creek.

ATTENDEE: When you say that you're doing it by phases and as you're waiting for funds to be accrued, is that for one section? Or are you lobbying for the whole 20-plus million? In other

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words, are you going to get funding for just the part where you start and then -- and then have to go in again to get funding for the next section? Or how --

MS. CANDICE TEICHERT: So we've asked that exact question at headquarters. And what we've been told is that once we go to the priority panel, all we have to do it is one time. And once they approve funding, then we may not receive the full 22, but it will be incremental after that. So we've asked that exact question.

ATTENDEE: And if it costs more?

MR. NESTER YOUNG: I don't know if you're asking about the rest of the site.

ATTENDEE: Well, the complete project versus -- you're talking about phasing it. This phase versus --

(Multiple speakers talking simultaneously.)

ATTENDEE: -- is the whole project going to be funded and you just -- you know --

MS. CANDICE TEICHERT: So for the remedy for this, we are phasing that. And once funding is approved, it's our understanding from headquarters that the priority panel is one time and they will

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fund it incrementally. The rest of this, we will actually -- we're in the process of beginning to investigate the rest of it right now.

ATTENDEE: So you don't even know what that will cost?

MS. CANDICE TEICHERT: That's right.

(Multiple speakers talking simultaneously.)

MR. NESTER YOUNG: -- many, many millions of dollars to address the rest of this, and we'll be back in this community in a few years proposing a plan for that area.

MS. CANDICE TEICHERT: For this area.

ATTENDEE: And you're going to have to go back and get more funding --

MR. NESTER YOUNG: Yes.

MS. CANDICE TEICHERT: Yes.

ATTENDEE: Okay.

ATTENDEE: So when you're saying goes before this panel -- so is there a list of the criteria that they use to rank us?

MR. NESTER YOUNG: Yes.

ATTENDEE: So how do we know what that is?

MR. NESTER YOUNG: I can provide the list to you. I think there are like five things that

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they look at. Human health is a top concern, of course, and they look at other things.

ATTENDEE: Is that something that can be put on the website, the criteria?

MR. NESTER YOUNG: I don't know.

MS. CANDICE TEICHERT: Yeah, I don't know either.

MR. NESTER YOUNG: We can provide that information if you want it. But just understand, we're competing with a site in New Jersey, a site in New Mexico, and they've got their own problems to deal with, you know. And the panel looks at it and they go okay, whose got the worst situation, and we're going to focus our attention on those sites first.

ATTENDEE: Would you be better off just going ahead and start digging for gold?

MS. CANDICE TEICHERT: Well --

(Multiple speakers talking simultaneously.)

MS. CANDICE TEICHERT: Okay. So we do know that there is gold. We know that there is gold out here. We do know that. And what we have considered, and what we will continue to consider, especially as we work this portion of the site and

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once we get into a remedial phase, which is what we're in right here and looking at remedies, is actually potentially reprocessing that material to help potentially fund the cleanup. So that is something that we are --

ATTENDEE: So you would sell the gold to fund this? Is that your understanding?

MS. CANDICE TEICHERT: Potentially. There are a lot of -- there are a lot of questions and issues.

MR. NESTER YOUNG: There are a lot of legal --

MS. CANDICE TEICHERT: Issues.

MR. NESTER YOUNG: -- issues related to that. There are a lot of regulatory issues related to that.

MS. CANDICE TEICHERT: Yeah.

MR. NESTER YOUNG: But rest assured that we're aware that there is gold out here and if we can potentially take it out and pay for the remedy, we'll try to do that.

MS. CANDICE TEICHERT: Right.

(Multiple speakers talking simultaneously.)

MR. NESTER YOUNG: Yeah. I don't think

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there's enough -- there's not enough gold there to pay for the entire remedy. I'll put it that way.

ATTENDEE: If that story leaks out, there will be people in there trying to dig for gold now.

MR. NESTER YOUNG: What you all can help us with is find a developer. If you want to redevelop that property, find somebody interested in developing it and we'll work with them.

MS. CANDICE TEICHERT: Right.

MR. NESTER YOUNG: There's 700 acres out there. Most of those acres aren't even touched. So if they want to develop part of that property, we'll work with those people and make it happen.

ATTENDEE: How much longer do you think this is going to be? I'm 97 years old.

MR. CHARLES COOK: We could do that, but somebody would have to tell us environmentally whether we're jumping out of a frying pan and into the fire.

MR. NESTER YOUNG: Right. That's the piece that we can help you with. Believe me, we've -- we have other sites that we are working with developers on to redevelop those sites. And although there's some contamination at those sites, we've helped them redevelop the site by giving them

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assurances and liability protections and things like that.

ATTENDEE: But do you continue cleaning the site --

MR. NESTER YOUNG: Yes.

ATTENDEE: -- and do you continue doing the work that you were --

MS. CANDICE TEICHERT: Yes.

MR. NESTER YOUNG: Obviously we're not going to allow somebody to come in and put a boat dock in the pit. You know, or, you know, put a house on top of the waste rock dump or anything like that. That's off limits. But like I said, there's 700 acres out here, and most of it's not - - hasn't been touched. So if they wanted to redevelop a corner of the property and it's not contaminated, we will help you with that.

MS. CANDICE TEICHERT: Are there any other questions? Okay. Well, I want to thank everyone for their time. I appreciate you all coming out. I appreciate all of the questions.

MR. NESTER YOUNG: If you want to give us a list of your 20 questions --

MS. CANDICE TEICHERT: Yes.

MR. NESTER YOUNG: -- we will --

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MR. CHARLES COOK: We'll send them.

MS. CANDICE TEICHERT: Okay.

MR. CHARLES COOK: We'll go back -- we'll go back based on the discussion tonight and probably update it and then we'll send it.

(Meeting adjourned at 7:04 p.m.)

CERTIFICATE

STATE OF SOUTH CAROLINA:

I hereby certify that the foregoing transcript was taken down, as stated in the caption, and the colloquy, questions, and answers thereto were reduced to typewriting under my direction; that the foregoing pages 2 through 45 represent a true, complete, and correct transcript of the evidence given.

I further certify that I am not related to or are of counsel to the parties in the case; am not in the regular employ of counsel for any of said parties; nor am I in any way interested in the result of said case.

This, the 22nd day of March, 2020.

____

MELISSA M. WHITLOCK, CCR, CVR

NOTARY PUBLIC

MY COMMISSION EXPIRES 3/12/2024

APPENDIX B

STATE OF SOUTH CAROLINA CONCURRENCE

Healthy People. Healthy Communities.

July 6, 2020

Carol Monell, Director
Superfund and Emergency Management Division
US EPA, Region IV
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, Georgia 30303

Re: Barite Hill/Nevada Goldfields Superfund Site
SCN000407714
Interim Record of Decision for OU 1 Concurrence Letter

Dear Ms. Monell:

The South Carolina Department of Health and Environmental Control (SCDHEC or Department) has reviewed and concurs with all parts of the Interim Record of Decision (IROD) for OU 1 dated August 2020 for the Barite Hill/Nevada Goldfields Superfund Site located in McCormick County, South Carolina. In concurring with this IROD, the Department agrees that the Interim Remedy was selected in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 United States Code (USC) §9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, as amended.

This Interim Remedy consists of three phases implemented on the three Contaminated Media Zones: Pit Lake (CMZ-1), Capped Waste Rock (CMZ-2), and OU 1 Groundwater (CMZ-3). The three phases are as follows:

- Phase I: Install a barrier wall and/or grout curtain to divert OU 1 Groundwater from oxidizing the Capped Waste Rock.

- Phase II: Amend the Capped Waste Rock with reactants to neutralize and prevent acid generation, expand and/or enhance the engineered cover over the Capped Waste Rock, and possibly dewater the Capped Waste Rock area by extracting and pumping contaminated groundwater into the Pit Lake.

- Phase III: Amend the Pit Lake with alkalinity and organic carbon to increase pH and reduce metals concentrations, cap the Pit Lake floor to prevent groundwater from entering the Pit Lake and discharging to the North Tributary through fractures and seeps, install open limestone channels in the Pit Lake spillway and in stormwater conveyances into the Pit Lake, and monitor the water quality in the Pit Lake and in the North Tributary.

The Interim Remedy also requires Institutional Controls to be put in place at OU 1. These include restrictions in the use of shallow groundwater and the use of public notices, advisories, and signage to inform the public.

The response actions selected in this IROD are protective of human health and the environment and are intended to provide adequate protection from actual or threatened releases of hazardous substances in the short term until a final ROD for OU 1 is signed. Since this is an interim ROD, review of the data and remedy will be ongoing to develop a final remedy for OU 1 that meets the statutory requirements of CERCLA including Section 121.

The Interim Remedy for OU 1 is estimated to cost $21,302,200. The cost estimate is based on a 30-year timeframe and all available information regarding the scope of the response actions. The estimate may change as a result of new information and data collected during the Remedial Design phase.

SCDHEC agrees that the Interim Remedy presented in the IROD is protective of human health and the environment in the short term, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, and is cost-effective.

If you should have any questions regarding the Department's concurrence with the IROD, please contact Joel Padgett at (803) 898-0832.

Sincerely,

Henry J. Porter, Chief
Bureau of Land and Waste Management

Cc: Candice Teichert, EPA Region 4
Don Siron, BLWM
Ken Taylor, BLWM
Susan Fulmer, BLWM
Joel Padgett, BLWM
Sara MacDonald, BLWM
Chris McCluskey, EA Upstate Region
File # 20799

APPENDIX C

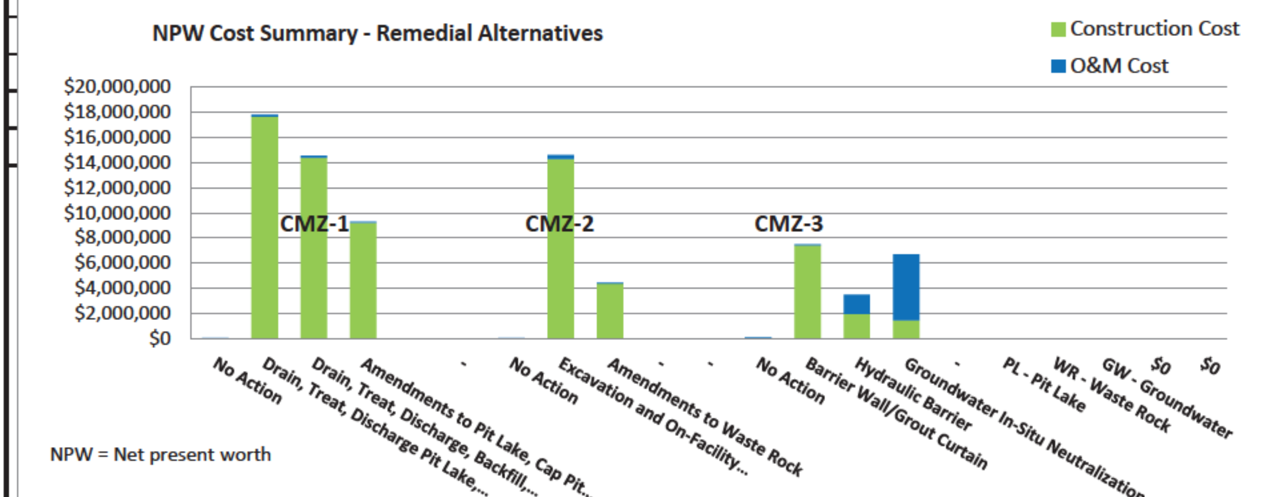
SELECTED REMEDY DETAILED COST ESTIMATE SHEETS

Feasibility Study Cost Estimate Summary

Project:	Barite Hill	Report:	Feasibility Study Cost Estimate		
Location:	McCormick, SC	Project Number:	049038	Revision:	0
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Stage:	0
Operable Unit:	1	Estimated By:	RGD	Checked By:	ECH

Alternative	Description	Construction Cost	O&M Cost	Yrs	NPW Total
CMZ-1 Pit Lake					
PL#1	No Action	$0	$94,160	30	$94,200
PL#2	Drain, Treat, Discharge Pit Lake, Backfill	$17,636,097	$142,394	30	$17,778,500
PL#3	Drain, Treat, Discharge, Backfill, Wetland	$14,394,139	$155,863	30	$14,550,000
PL#4	Amendments to Pit Lake, Cap Pit Floor	$9,224,251	$91,476	30	$9,315,700
-	-	-	-	-	-
-	-	-	-	-	-
CMZ-2 Waste Rock Area					
WR#2	No Action	$0	$91,084	30	$91,100
WR#2	Excavation and On-Facility Encapsulation	$14,258,471	$325,857	30	$14,584,300
WR#3	Amendments to Waste Rock	$4,400,646	$79,079	30	$4,479,700
-	-	-	-	-	-
-	-	-	-	-	-
CMZ-3 Groundwater					
GW#1	No Action	$0	$122,206	30	$122,200
GW#2A	Barrier Wall/Grout Curtain	$7,432,326	$74,495	30	$7,506,800
GW#2B	Hydraulic Barrier	$1,995,286	$1,525,832	30	$3,521,100
GW#3	Groundwater In-Situ Neutralization	$1,467,917	$5,253,119	30	$6,721,000
-	-	-	-	-	-

Notes: PL - Pit Lake
WR - Waste Rock
GW - Groundwater



NPW = Net present worth

Feasibility Study Cost Estimate

		Alternative #:	PL#1	CMZ-1, Pit Lake #1	Total NPW Cost: $94,200
Project:	Barite Hill	Title:	No Action		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2016
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0

Task Description: Sitewide costs applicable to each remedial alternative. Includes costs for 5YRs, maintenance of land use restrictions, site inspections. Includes LTM costs for sampling COCs in pit lake every 5 years for 30 years.

Cost Basis: Detailed estimate

Item	Qty.	Unit	Unit Cost	Note	Cost ($)
Capital Costs					
				Subtotal - Capital Costs:	$ -
Capital Contingency	30%	of Capital Cost			$ -
Legal Fees, Licenses & Permits[1]	0.5%				$ -
Engineering & Administrative[1]	8%				$ -
Contractor Fee[2]	10%	of Capital Cost			$ -
				Total Capital Cost:	$ -

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

O&M Costs

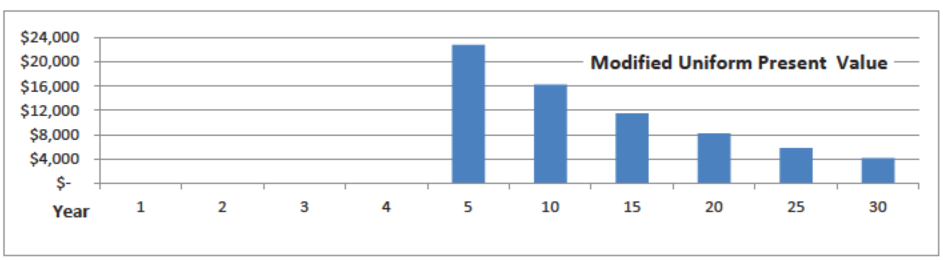
O&M Period	30
Discount Rate	7.00%
Constant Escalation Factor	0.00%

1.0 Site-Wide Costs and Monitoring (Year 1 to Year 30)

Sample surface water in pit lake at two locations from 3 depths field parameters, COCs every 5 years for 30 years (6 events); 8 hour day - 2 day effort, 6 hr travel, 4 hr prep. Site maintenance. Complete 5-Yr Reviews and general support to EPA.

Item			Qty.	Unit	Unit Cost	Annual Cost
Labor	30	yr	1	total	$ 20,667	$ 20,667
Travel	30	yr	1	total	$ 4,230	$ 4,230
Materials/Equipment/Subcontractors	30	yr	1	total	$ 3,570	$ 3,570
Analytical - Soil	30	yr	1	total	$ -	$ -
Analytical - Water	30	yr	1	total	$ 3,473	$ 3,473
						$ 31,940

5 Frequency of Periodic Annual Cost (yrs)



		Net Present Worth (NPW) Subtotal:	$ 68,921
O&M Contingency	15%	of NPW Cost	$ 10,338
Engineering & Administrative[1]	8%		$ 6,341
Contractor Fee[2]	10%		$ 8,560
		Subtotal - O&M Costs:	$ 94,160

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

Net Present Worth derived from summation of Modified Uniform Present Value

Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1-\left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Total NPW Cost Estimate: $ 94,200

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate

Total NPW Cost: $17,778,500

Project:	Barite Hill	**Alternative #:**	PL#2 — CMZ-1 Pit Lake #2
Location:	McCormick, SC	**Title:**	Drain, Treat, Discharge Pit Lake, Backfill
Project Phase:	OU1 FS Rev 0	**Project Number:**	049038
		Date:	6/14/2018
		Base Year:	2107
		Revision:	0

Task Description: Construct temporary waste water treatment system. Drain and treat pit lake water (~73 Mgal). Discharge treated water to the North Tributary. Line pit floor with limestone and clay. Backfill pit with offsite borrow material to level of spillway (~400,000 cy)

Cost Basis: Detailed estimate with subcontractor quotes

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
	Capital Costs					
1.0	**Remedial Design/Bench Scale/Pilot Tests**					
	Labor	1	ls	$ 81,732		$ 81,732
	Materials/Equipment/Subcontractors	1	ls	$ 500		$ 500
			Design/Bench/Pilot Scale Subtotal:			**$ 82,232**
2.0	**Mobilization/Demobilization of Equipment and Personnel**					
	Mobilization/Demobilization of equipment and personnel (1/1 days)					
	Labor	1	ls	$ 27,945		$ 27,945
	Travel	1	ls	$ 5,044		$ 5,044
	Materials/Equipment/ Subcontractors	1	ls	$ 11,308		$ 11,308
			Mobilization Subtotal:			**$ 44,297**
3.0	**Site Preparation**					
	Utility protection, grubbing, clearing, pre excavation meeting, materials (1 days);					
	Materials/Equipment/ Subcontractors	1	ls	$ 12,935		$ 12,935
			Site Preparation Subtotal:			**$ 12,935**
4.0	**Drain Pit Lake, Treat and Discharge Water**					
	Drain Pit Lake, Treat Lake Water, Discharge to North Tributary					
	Treatment System Construction	1	ls	$ 610,000		$ 610,000
	Treatment and Discharge	1	ls	$ 2,800,000		$ 2,800,000
			Drain, Treat Lake water, Discharge:			**$ 3,410,000**
5.0	**Amendments to Pit Floor**					
	Add Amendments (Lime) to Pit Floor					
	Labor	1	ls	$ 22,572		$ 22,572
	Travel	1	ls	$ 4,824		$ 4,824
	Materials/Equipment/ Subcontractors	1	ls	$ 1,623,500		$ 1,623,500
			Liner Installation Subtotal:			**$ 1,650,897**
8.0	**Backfill Placement**					
	Clean backfill of all soils.					
	Backfill with Clean Soil	400,000	lcy	$ 19.00		$ 7,600,000
			Backfill Subtotal:			**$ 7,600,000**
9.0	**Site Restoration**					
	Contour Pit Cover, Restore vegetation					
	Final grade and restore	8	acre	$ 4,500.00		$ 34,917
	Restore Vegetation	7.76	acre	$ 1,818		$ 14,104
			Site Restoration Subtotal:			**$ 49,021**

Notes:

1)

2)

		Subtotal - Capital Costs:	$ 12,849,382
Capital Contingency	15%	of Capital Cost	$ 1,927,407
Legal Fees, Licenses & Permits[1]	0.5%		$ 73,884
Engineering & Administrative[1]	8%		$ 1,182,143
Contractor Fee[2]	10%	of Capital Cost	$ 1,603,282
		Total Capital Cost:	$ 17,636,097

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	PL#2 — CMZ-1 Pit Lake #2
Location:	McCormick, SC	Title:	Drain, Treat, Discharge Pit Lake, Backfill

Item			Qty.	Unit	Unit Cost	Note	Cost ($)

O&M Costs

O&M Period		
	7.00%	Discount Rate
	0.00%	Constant Escalation Factor

10.0 Cover O&M Costs — Annual Cost

Maintenance of vegetation cover and inspect repair pit cover for 30 years.

Item	O&M Period		Qty.	Unit	Unit Cost	Annual Cost
Labor	30	yr	1	total	$ 4,733	$ 4,733
Travel	30	yr	1	total	$ 166	$ 166
Materials/Equipment/Subcontractors	30	yr	1	total	$ 3,500	$ 3,500
Analytical - Water	30	yr	1	total	$ -	$ -
		yr		total	$ -	$ -
		yr		total	$ -	$ -
						$ 8,399

Frequency of Periodic Annual Cost: 1 yrs

Net Present Worth (NPW) Subtotal: $ 104,226

O&M Contingency	15%	of NPW Cost	$ 15,634
Engineering & Administrative[1]	8%		$ 9,589
Contractor Fee[2]	10%		$ 12,945

[1] Applied to O&M subtotal and contingency
[2] Applied to O&M subtotal, contingency, and E&A

Subtotal - O&M Costs: $ 142,394

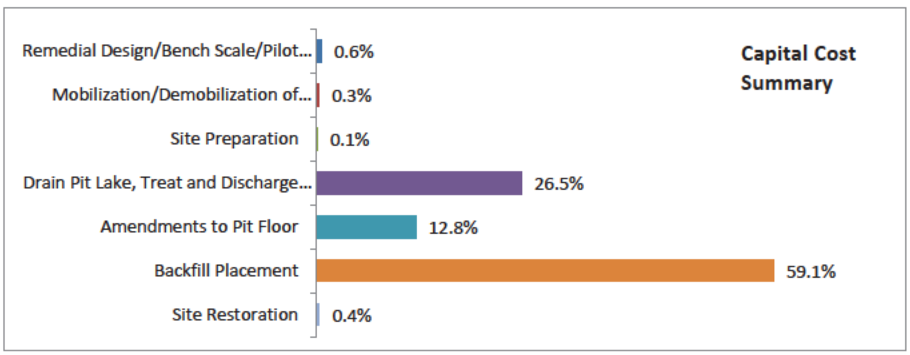
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 17,778,500



General Assumptions

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate				Total NPW Cost:	$14,550,000
		Alternative #:	PL#3	CMZ-1, Pit Lake #3	
Project:	Barite Hill	Title:	Drain, Treat, Discharge, Backfill, Wetland		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2017
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0
Task Description:	Construct temporary waste water treatment system. Drain and treat pit lake water (~73 Mgal). Discharge treated water to the North Tributary. Line pit floor with lime. Partially backfill pit (~250,000 cy) with onsite fill material, Create wetland				
Cost Basis:	Detailed estimate with subcontractor quotes				

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
	Capital Costs					
1.0	**Remedial Design/Bench Scale/Pilot Tests**					
	Labor	1	ls	$ 81,732		$ 81,732
	Materials/Equipment/Subcontractors	1	ls	$ 500		$ 500
				Design/Bench/Pilot Scale Subtotal:		**$ 82,232**
2.0	**Mobilization/Demobilization of Equipment and Personnel**					
	Mobilization/Demobilization of equipment and personnel (1/1 days)					
	Labor	1	ls	$ 27,945		$ 27,945
	Travel	1	ls	$ 5,044		$ 5,044
	Materials/Equipment/ Subcontractors	1	ls	$ 11,308		$ 11,308
				Mobilization Subtotal:		**$ 44,297**
3.0	**Site Preparation**					
	Utility protection, grubbing, clearing, pre excavation meeting, materials (1 days);					
	Materials/Equipment/ Subcontractors	1	ls	$ 12,935		$ 12,935
				Site Preparation Subtotal:		**$ 12,935**
4.0	**Drain Pit Lake, Treat and Discharge Water**					
	Excavation of soils; staging of soils.					
	Treatment System Construction	1	ls	$ 610,000		$ 610,000
	Treatment and Discharge	1	ls	$ 2,800,000		$ 2,800,000
				Soil Excavation and Staging Subtotal:		**$ 3,410,000**
5.0	**Amendments to Pit Floor**					
	Add amendments (lime) to pit floor					
	Labor	1	ls	$ 22,572		$ 22,572
	Travel	1	ls	$ 3,444		$ 3,444
	Materials/Equipment/ Subcontractors	1	ls	$ 1,623,000		$ 1,623,000
				Liner Installation Subtotal:		**$ 1,649,017**
6.0	**Backfill Placement**					
	Partially backfill pit					
	Mobilization	1	ls	$ 4,750,000		$ 4,750,000
				Composite Cap Subtotal:		**$ 4,750,000**

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	PL#3 — CMZ-1, Pit Lake #3
Location:	McCormick, SC	Title:	Drain, Treat, Discharge, Backfill, Wetland

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
7.0	**Wetland Construction**					
	Construct a wetland within the partially backfilled pit lake (~6 acres).					
	Install wetland	1	ls	$ 489,840		$ 489,840
			Transport and Disposal Subtotal:			**$ 489,840**
8.0	**Site Restoration**					
	Replace liner and restore vegetation					
	Final grade and restore	8	bcy	$ 4,500.00		$ 34,917
	Restore Vegetation	7.76	ls	$ 1,818		$ 14,104
			Site Restoration Subtotal:			**$ 49,021**
	Notes:					
1)						
2)						

		Subtotal - Capital Costs:	**$ 10,487,342**
Capital Contingency	15%	of Capital Cost	$ 1,573,101
Legal Fees, Licenses & Permits[1]	0 5%		$ 60,302
Engineering & Administrative[1]	8%		$ 964,835
Contractor Fee[2]	10%	of Capital Cost	$ 1,308,558
		Total Capital Cost:	**$ 14,394,139**

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	PL#3 — CMZ-1, Pit Lake #3
Location:	McCormick, SC	Title:	Drain, Treat, Discharge, Backfill, Wetland

Item			Qty.	Unit	Unit Cost		Note	Cost ($)	
O&M Costs									
	O&M Period		7.00%	Discount Rate					
			0.00%	Constant Escalation Factor					
10.0 Wetland O&M Costs								**Annual Cost**	
Maintenance of vegetation cover and inspect wetland for 30 years. Vist every 2nd year									
Labor	30	yr	1	total	$	5,424		$	5,424
Travel	30	yr	1	total	$	269		$	269
Materials/Equipment/Subcontractors	30	yr	1	total	$	3,500		$	3,500
Analytical - Water	30	yr	1	total	$	-		$	-
		yr		total	$	-		$	-
		yr		total	$	-		$	-
								$	9,194
Frequency of Periodic Annual Cost:	1	yrs							
				Net Present Worth (NPW) Subtotal:				$	114,085
O&M Contingency			15%	of NPW Cost				$	17,113
Engineering & Administrative[1]			8%					$	10,496
Contractor Fee[2]			10%					$	14,169
				Subtotal - O&M Costs:				$	155,863

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)

Ao = Annual Amount ($)

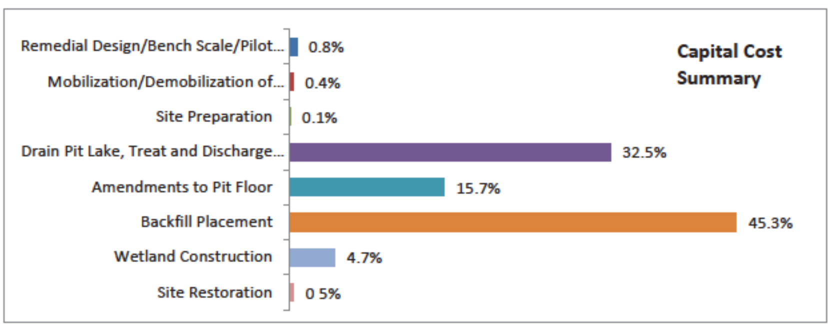
d = discount rate

e = escalation factor

n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 14,550,000



General Assumptions

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate				Total NPW Cost:	$9,315,700
		Alternative #:	PL#4	CMZ-1 Pit Lake #4	
Project:	Barite Hill	Title:	Amendments to Pit Lake, Cap Pit Floor		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2017
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0

Task Description: *Pit Lake Neutralization with Lime Addition followed by Alkalinity addition to Sustain Neutralization, Pit Lake Bottom Encapsulation*

Cost Basis: Detailed estimate provided by (Sovereign) with input from B&V

Item	Qty.	Unit	Unit Cost	Note	Cost ($)
Capital Costs					
1.0 Remedial Design/Bench Scale/Pilot Tests					
Remedial Design, RD support tasks (plans, field investigation, coordination with agencies, permits), travel, treatability and/or pilot tests, site surveys, design vendor support.					
Labor	1	ls	$ 59,985		$ 59,985
RD Support	1	ls	$ 8,000		$ 8,000
Travel	1	ls	$ 7,020		$ 7,020
			Design/Bench/Pilot Testing Subtotal:		**$ 75,005**
2.0 Mobilization/Demobilization of Equipment and Personnel					
Mobilization/Demobilization of equipment and personnel (2/2 days).					
Labor	1	ls	$ 28,360		$ 28,360
Travel	1	ls	$ 4,778		$ 4,778
Materials/Equipment/ Subcontractors	1	ls	$ 200		$ 200
			Mobilization Subtotal:		**$ 33,338**
3.0 Site Preparation					
Utility protection, grubbing, clearing, pre excavation meeting, materials (3 days).					
Materials/Equipment/ Subcontractors	1	ls	$ 4,400		$ 4,400
			Site Preparation Subtotal:		**$ 4,400**
4.0 Pit Lake Neutralization					
Neutralization of the pit lake using lime, limestone, wood products and organic material.					
Bulk Neutralization	1	ls	$ 627,100		$ 627,100
Alkalinity Addition	1	ls	$ 3,328,800		$ 3,328,800
			Pit Lake NeutralizationI Subtotal:		**$ 3,955,900**

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	PL#4 CMZ-1 Pit Lake #4
Location:	McCormick, SC	Title:	Amendments to Pit Lake, Cap Pit Floor

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
5.0	**Pit Floor Encapsulation**					
	Install AquaBlok® within pit lake to encapsulate the pit floor.					
	AquaBlock Subcontractor	1	ls	$ 2,652,000		$ 2,652,000
				Pit Floor Encapsulation Subtotal:		**$ 2,652,000**
	Notes:					
1)						

		Subtotal - Capital Costs:	**$ 6,720,643**
Capital Contingency	15%	of Capital Cost	$ 1,008,096
Legal Fees, Licenses & Permits[1]	0.5%		$ 38,644
Engineering & Administrative[1]	8%		$ 618,299
Contractor Fee[2]	10%	of Capital Cost	$ 838,568
		Total Capital Cost:	**$ 9,224,251**

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	PL#4 — CMZ-1 Pit Lake #4
Location:	McCormick, SC	Title:	Amendments to Pit Lake, Cap Pit Floor

O&M Costs

Item	O&M Period		Qty.	Unit	Unit Cost		Note	Cost ($)	
			7.00%	Discount Rate					
			0.00%	Constant Escalation Factor					
8.0 Performance Monitoring/O&M	5							**Annual Cost**	
Collect samples from pit lake. Two locations from two depths.									
Labor	5	yr	1	total	$	1,729		$	1,729
Travel	5	yr	1	total	$	575		$	575
Materials/Equipment/Subcontractors	5	yr	1	total	$	12,000		$	12,000
Analytical - Water	5	yr	1	total	$	2,026		$	2,026
								$	16,330
				Net Present Worth (NPW) Subtotal:				$	66,957
O&M Contingency			15%	of NPW Cost				$	10,044
Engineering & Administrative[1]			8%					$	6,160
Contractor Fee[2]			10%					$	8,316
				Subtotal - O&M Costs:				$	91,476

[1] Applied to O&M subtotal and contingency
[2] Applied to O&M subtotal, contingency, and E&A

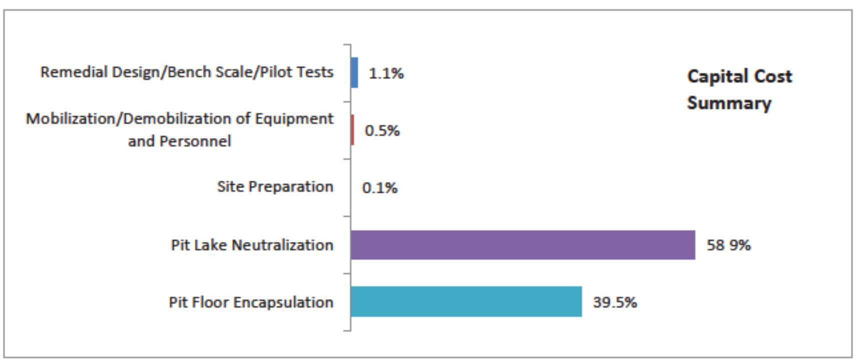
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where:
P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 9,315,700



General Assumptions
1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate

		Total NPW Cost:	**$91,100**
		Alternative #:	**WR#1** — **CMZ-2, Waste Rock #1**
Project:	**Barite Hill**	**Title:**	**No Action**
Location:	McCormick, SC	**Project Number:**	049038
Project Phase:	OU1 FS Rev 0	**Date:**	6/14/2018
		Base Year:	2016
		Revision:	0

Task Description: Sitewide costs applicable to each remedial alternative. Includes costs for 5YRs, maintenance of land use restrictions, site inspections. Includes LTM costs for inspection and repair of waste rock cap for 30 years.

Cost Basis: Detailed estimate

Item	Qty.	Unit	Unit Cost	Note	Cost ($)

Capital Costs

Subtotal - Capital Costs:			$ -
Capital Contingency	15%	of Capital Cost	$ -
Legal Fees, Licenses & Permits[1]	0.5%		$ -
Engineering & Administrative[1]	8%		$ -
Contractor Fee[2]	10%	of Capital Cost	$ -
Total Capital Cost:			$ -

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

O&M Costs

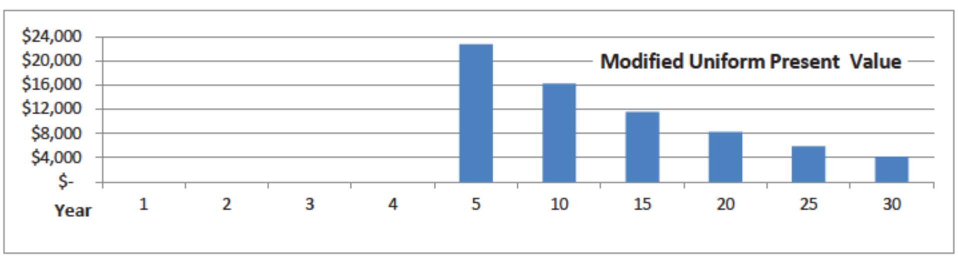
O&M Period	30		
		7.00%	Discount Rate
		0.00%	Constant Escalation Factor

1.0 Site-Wide Costs and Monitoring (Year 1 to Year 30) — **Annual Cost**

Inspect and repair, as needed, waste rock cap every 5 years for 30 years (6 events); 8 hour day - 2 day effort, 6 hr travel, 4 hr prep. Site maintenance. Complete 5-Yr Reviews and general support to EPA.

Item	Qty.	Unit			Unit Cost	Annual Cost
Labor	30	yr	1	total	$ 20,667	$ 20,667
Travel	30	yr	1	total	$ 4,230	$ 4,230
Materials/Equipment/Subcontractors	30	yr	1	total	$ 6,000	$ 6,000
Analytical - Soil	30	yr	1	total	$ -	$ -
Analytical - Water	30	yr	1	total	$ -	$ -
						$ 30,897

5 — Frequency of Periodic Annual Cost (yrs)



Net Present Worth (NPW) Subtotal:			$ 66,670
O&M Contingency	15%	of NPW Cost	$ 10,000
Engineering & Administrative[1]	8%		$ 6,134
Contractor Fee[2]	10%		$ 8,280
Subtotal - O&M Costs:			$ 91,084

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

Net Present Worth derived from summation of Modified Uniform Present Value (UPV*)

Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Total NPW Cost Estimate: $ 91,100

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate				Total NPW Cost:	$14,584,300
		Alternative #:	WR#2	CMZ-2, Waste Rock #2	
Project:	Barite Hill	Title:	Excavation and On-Facility Encapsulation		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2017
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0

Task Description: Excavation of capped waste rock and transport to designated area on-site. Encapsulation of excavated waste rock. Clean backfill, grade and vegetative cover.

Cost Basis: Detailed estimate with subcontractor quotes

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
	Capital Costs					
1.0	**Remedial Design/Bench Scale/Pilot Tests**					
	Labor	1	ls	$ 77,790		$ 77,790
	Travel	1	ls	$ 800		$ 800
	Materials/Equipment/Subcontractors	1	ls	$ 500		$ 500
			Design/Bench/Pilot Scale Subtotal:			**$ 79,090**
2.0	**Mobilization/Demobilization of Equipment and Personnel**					
	Mobilization/Demobilization of equipment and personnel (1/1 days)					
	Labor	1	ls	$ 27,945		$ 27,945
	Travel	1	ls	$ 5,044		$ 5,044
	Materials/Equipment/ Subcontractors	1	ls	$ 11,308		$ 11,308
			Mobilization Subtotal:			**$ 44,297**
3.0	**Site Preparation**					
	Utility protection, grubbing, clearing, pre excavation meeting, materials (1 days);					
	Labor	1	ls	$ 31,274		$ 31,274
	Materials/Equipment/ Subcontractors	1	ls	$ 53,984		$ 53,984
			Site Preparation Subtotal:			**$ 85,258**
4.0	**Install Sheet Pile Wall**					
	Install 500-ft of sheet pile wall along the west side of excavation to 25 ft bls to keep out pit lake water.					
	Shoring Subcontractor	500	ft	$ 1,678		$ 839,000
			Sheet Pile Wall Subtotal:			**$ 839,000**
5.0	**Waste Rock Excavation and Staging**					
	Excavation of soils; staging of soils.					
	Excavate Clean Overburden	1	ls	$ 385,200		$ 385,200
	Excavate Soils (Waste Rock)	1	ls	$ 3,358,500		$ 3,358,500
			Waste Rock Excavation and Staging Subtotal:			**$ 3,743,700**
6.0	**Geosynthetic Clay Liner for Surface Soil Cap**					
	GCL Installation with clean soil cover					
	Mobilization	1	ls	$ 25,000		$ 25,000
	Subcontract Labor	1	ls	$ 720,661		$ 720,661
	Liner and Geocomposite	1	ls	$ 480,000		$ 480,000
			Composite Cap Subtotal:			**$ 1,225,661**

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	WR#2 CMZ-2, Waste Rock #2
Location:	McCormick, SC	Title:	Excavation and On-Facility Encapsulation

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
7.0	**Backfill Placement**					
	Backfill waste rock excavation with clean soil from off-site.					
	Backfill Overburden/Clean/Treated Soils	256,000	bcy	$ 16.62		$ 4,254,720
	Place Impacted Soil on Cap		lcy	$ -		$ -
				Backfill Subtotal:		**$ 4,254,720**
8.0	**Site Restoration**					
	Replace liner and restore vegetation					
	Final grade and restore	7	bcy	$ 4,500.00		$ 29,752
	Restore Vegetation	6.61	ls	$ 1,818		$ 12,017
	Stormwater Controls	1.00	ls	$ 75,000		$ 75,000
				Site Restoration Subtotal:		**$ 116,769**
	Notes:					
1)						
2)						
				Subtotal - Capital Costs:		**$ 10,388,496**
	Capital Contingency	15%	of Capital Cost			$ 1,558,274
	Legal Fees, Licenses & Permits[1]	0 5%				$ 59,734
	Engineering & Administrative[1]	8%				$ 955,742
	Contractor Fee[2]	10%	of Capital Cost			$ 1,296,225
				Total Capital Cost:		**$ 14,258,471**

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	WR#2 — CMZ-2, Waste Rock #2
Location:	McCormick, SC	Title:	Excavation and On-Facility Encapsulation

Item			Qty.	Unit	Unit Cost	Note	Cost ($)

O&M Costs

O&M Period	30	yrs	7.00%	Discount Rate	
			0.00%	Constant Escalation Factor	

9.0 Liner/Cover O&M Costs — Annual Cost

Maintenance of vegetation cover and inspect repair cap for 30 years.

Item			Qty.	Unit	Unit Cost	Annual Cost
Labor	30	yr	1	total	$ 5,856	$ 5,856
Travel	30	yr	1	total	$ 1,364	$ 1,364
Materials/Equipment/Subcontractors	30	yr	1	total	$ 12,000	$ 12,000
Analytical - Water	30	yr	1	total	$ -	$ -
		yr		total	$ -	$ -
		yr		total	$ -	$ -
						$ 19,221

Frequency of Periodic Annual Cost: 5 yrs

Net Present Worth (NPW) Subtotal: $ 238,513

O&M Contingency	15%	of NPW Cost	$ 35,777
Engineering & Administrative[1]	8%		$ 21,943
Contractor Fee[2]	10%		$ 29,623

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

Subtotal - O&M Costs: $ 325,857

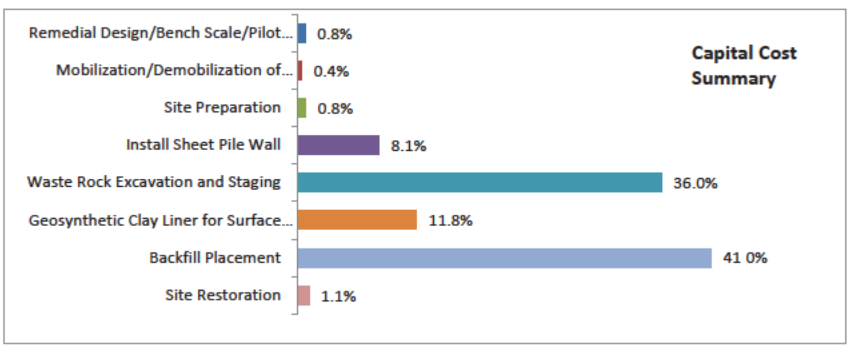
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 14,584,300



General Assumptions

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate				Total NPW Cost:	$4,479,700
		Alternative #:	WR#3	CMZ-2, Waste Rock #3	
Project:	Barite Hill	Title:	Amendments to Waste Rock		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2016
Project Phase:	FS	Date:	5/24/2018	Revision:	0

Task Description: Installation of both shallow and deep amendment injection wells. Construction of amendment mixing and delivery system. Add amendments to capped waste rock area.

Cost Basis: Detailed estimate with subcontractor quotes (Sovereign, 2018, Cascade, 2018)

Item	Qty.	Unit	Unit Cost	Note	Cost ($)
Capital Costs					
1.0 Remedial Design/Bench Scale/Pilot Tests					
Remedial Design, RD support tasks (plans, field investigation, coordination with agencies, permits), travel, treatability and/or pilot tests, site surveys, design vendor support.					
Labor	1	ls	$ 34,636		$ 34,636
RD Support	1	ls	$ 8,000		$ 8,000
Travel	1	ls	$ 645		$ 645
Treatability Testing	1	ls	$ 250,000		$ 250,000
			Design/Bench/Pilot Testing Subtotal:		**$ 293,281**
2.0 Clean Water Makeup System					
Construction of clean water makeup system for injections.					
Materials/Equipment/ Subcontractors	1	ls	$ 37,500		$ 37,500
			Mobilization Subtotal:		**$ 37,500**
3.0 Buffered Milk Amendment Makeup System					
Construction of bufferd milk makeup system for injections.					
Materials/Equipment/ Subcontractors	1	ls	$ 532,000		$ 532,000
			Site Preparation Subtotal:		**$ 532,000**
4.0 Deep Well Injections - Plus all amendments and amendments mix/injection system, and operations of system					
Install 15 deep injection wells. 5 in regolith. 10 into bedrock. Inject amendments into wells within waste rock area					
Treatment Subcontractor	1	ls	$ 1,240,555		$ 1,240,555
			Deep Well Subtotal:		**$ 1,240,555**
5.0 Shallow Well Injections					
Install approximately 100 shallow (~10 ft bls) injection wells. 2" diameter with 5-foot screens. Installed using DPT. Inject amendments into waste rock.					
Treatment Subcontractor	1	ls	$ 1,102,905		$ 1,102,905
			Shallow Well Subtotal:		**$ 1,102,905**

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	WR#3 CMZ-2, Waste Rock #3
Location:	McCormick, SC	Title:	Amendments to Waste Rock

Item	Qty.	Unit	Unit Cost	Note	Cost ($)

Notes:

1)

		Subtotal - Capital Costs:	**$ 3,206,241**
Capital Contingency	15%	of Capital Cost	$ 480,936
Legal Fees, Licenses & Permits[1]	0.5%		$ 18,436
Engineering & Administrative[1]	8%		$ 294,974
Contractor Fee[2]	10%	of Capital Cost	$ 400,059
		Total Capital Cost:	**$ 4,400,646**

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	WR#3 — CMZ-2, Waste Rock #3
Location:	McCormick, SC	Title:	Amendments to Waste Rock

Item			Qty.	Unit	Unit Cost		Note	Cost ($)
O&M Costs								
	O&M Period		7.00%	Discount Rate				
			0.00%	Constant Escalation Factor				
6.0 Performance Monitoring/O&M	5							**Annual Cost**
Sample 4 monitoring wells within former waste rock areal for field parameters and COCs quarterly every year for 5 years (20 events); 9 hour day - 2 day effort, 6 hr travel, 4 hr prep.								
Labor	5	yr	1	total	$	5,491		$ 5,491
Travel	5	yr	1	total	$	2,060		$ 2,060
Materials/Equipment/Subcontractors	5	yr	1	total	$	4,250		$ 4,250
Analytical - Water	5	yr	1	total	$	2,315		$ 2,315
								$ **14,117**
							Net Present Worth (NPW) Subtotal:	$ **57,882**
O&M Contingency			15%	of NPW Cost				$ 8,682
Engineering & Administrative[1]			8%					$ 5,325
Contractor Fee[2]			10%					$ 7,189
							Subtotal - O&M Costs:	$ **79,079**

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

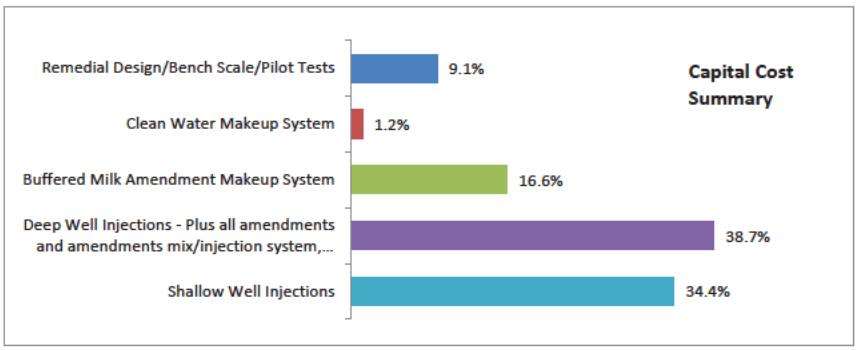
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where:
- P = Present Value ($)
- Ao = Annual Amount ($)
- d = discount rate
- e = escalation factor
- n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ **4,479,700**



General Assumptions

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate

Total NPW Cost:	$122,200		
Alternative #:	GW#1	CMZ-2, Groundwater #1	
Project:	Barite Hill	Title:	No Action
Location:	McCormick, SC	Project Number:	049038
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018
Base Year:	2016	Revision:	0

Task Description: Sitewide costs applicable to each remedial alternative. Includes costs for 5YRs, maintenance of land use restrictions, site inspections. Includes LTM costs for sampling 14 goundwater montoring wells for COCs for 30 years.

Cost Basis: Detailed estimate

Item	Qty.	Unit	Unit Cost	Note	Cost ($)
Capital Costs					
				Subtotal - Capital Costs:	$ -
Capital Contingency	15%	of Capital Cost			$ -
Legal Fees, Licenses & Permits[1]	0.5%				$ -
Engineering & Administrative[1]	8%				$ -
Contractor Fee[2]	10%	of Capital Cost			$ -
				Total Capital Cost:	$ -

[1] Applied to capital subtotal and contingency
[2] Applied to capital subtotal, contingency, fees, and E&A

O&M Costs

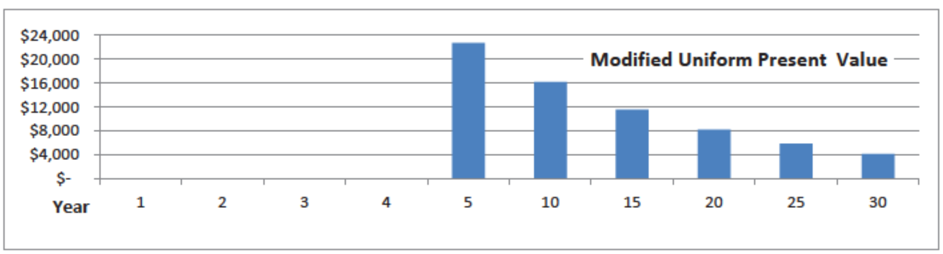
O&M Period	30
Discount Rate	7.00%
Constant Escalation Factor	0.00%

1.0 Site-Wide Costs and Monitoring (Year 1 to Year 30)

Sample 14 groundwater monitoring wells every 5 years for 30 years (6 events); 8 hour day - 3 day effort, 6 hr travel, 4 hr prep. Site maintenance. Complete 5-Yr Reviews and general support to EPA.

Item	Qty.	Unit			Unit Cost	Annual Cost
Labor	30	yr	1	total	$ 22,702	$ 22,702
Travel	30	yr	1	total	$ 4,648	$ 4,648
Materials/Equipment/Subcontractors	30	yr	1	total	$ 6,000	$ 6,000
Analytical - Soil	30	yr	1	total	$ -	$ -
Analytical - Water	30	yr	1	total	$ 8,104	$ 8,104
						$ 41,454

5 Frequency of Periodic Annual Cost (yrs)



		Net Present Worth (NPW) Subtotal:	$ 89,450
O&M Contingency	15%	of NPW Cost	$ 13,417
Engineering & Administrative[1]	8%		$ 8,229
Contractor Fee[2]	10%		$ 11,110
		Subtotal - O&M Costs:	$ 122,206

[1] Applied to O&M subtotal and contingency
[2] Applied to O&M subtotal, contingency, and E&A

Net Present Worth derived from summation of Modified Uniform Present Value (UPV*)

Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Total NPW Cost Estimate: $ 122,200

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate				Total NPW Cost:	$7,506,800
		Alternative #:	GW#2A	CMZ-3, Groundwater #2A	
Project:	Barite Hill	Title:	Barrier Wall/Grout Curtain		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2017
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0

Task Description: Construct Vertical Engineered Barrier to divert GW away from Waste Rock Area and Pit Lake: Upgradient barrier wall (600-ft) to top of bedrock (70 ft bls). Grout Curtain within bedrock from 70 ft bls to 160 bls. Install open limestone-lined channels at pit lake spillway and storm water discharge points into Pit Lake. Includes dewatering capped waste rock.

Cost Basis: Experience (Brunswick, Camilla BW's, Boone Dam Site)

Capital Costs

Item	Qty.	Unit	Unit Cost	Note	Cost ($)
1.0 Slurry Wall and Grout Curtain Design					
Remedial Design, RD support taks (plans, field investigation, coordination with agencies, permits), travel, treatability and/or pilot tests, site surveys, design vendor support.					
Remedial Design Professional Labor	1	ls	$ 31,447		$ 31,447
RD Support	1	ls	$ 55,500		$ 55,500
Travel	1	ls	$ 1,560		$ 1,560
Subcontractors/ODC	1	ls	$ 130,000		$ 130,000
Bench Scale Testing	1	ls	$ 38,300		$ 38,300
				Design Subtotal:	**$ 256,807**
2.0 Site Preparation					
Utility protection, grubbing, clearing, pre excavation meeting, materials					
Materials/Equipment/Subcontractors	1	ls	$ 35,213		$ 35,213
				per	**$ 35,213**
3.0 Grout Curtain					
Strip up 80-feet of railroad track along edges of treatment zone, stage and replace at end of project					
Grout Curtain Installation	1	ls	$ 3,588,273		$ 3,588,273
Roadway Removal/Replacement	1	ls	$ -		$ -
				Grout Curtan Subtotal:	**$ 3,588,273**
4.0 Slurry Wall Construction					
Procurement, planning, preparation, and installation of 600-ft slurry wall to an average depth of 70-ft bls.					
Trench Wall Thickness 3 ft					
Depth of Wall 70 ft					
Perimeter Linear Feet 600 ft					
Cap Area: 42,000 sf					
Mobilize/Demobilize Drilling Rig & Crew	1	ls	$ 15,003		$ 15,003
Field/Construction Oversight (Labor):	1	ls	$ 216,938		$ 216,938
Oversight Travel	1	ls	$ 32,250		$ 32,250
Prepare/Update Plans (Workplan, CM, CQAP, HASP)	1	ls	$ 25,000		$ 25,000
Perimeter Work Platform	4,500	cy	$ 7 00		$ 31,500
Excavation/Trenching, and Construction of Slurry Wall	42,000	sf	$ 18 00		$ 756,000
Miscellaneous	1	ls	$ 7,835		$ 7,835
Decon Rig, Augers, Screen (Rental Equipment)	1	ls	$ 7,940		$ 7,940
Stabilization of Trench Spoils	1	ls	$ 39,816		$ 39,816
				Slurry Wall Subtotal:	**$ 1,132,283**

Notes:

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Feasibility Study Cost Estimate					
Project: Barite Hill	Alternative #: GW#2A	CMZ-3, Groundwater #2A			
Location: McCormick, SC	Title: Barrier Wall/Grout Curtain				

Item	Qty.	Unit	Unit Cost	Note	Cost ($)
5.0 OLC Installations					
Installation of open limestone channels at the pit lake spillway and channels where storm water discharges into the pit lake.					
Mobilization, Utility Locates/Demobilization	1	ls	$ 2,500		$ 2,500
Limestone	500	tons	$ 50		$ 25,000
Consturction of channe 181,120 sf	1	cy	$ 75,000.00		$ 75,000
					$ 102,500
6.0 Dewatering Waste Rock					
Dewatering system to remove groundwater from waste rock					
Dewatering System	1.00	acres	$ 200,000.0		$ 200,000
Dewatering System Monitoring	1.00	acres	$ 100,000		$ 100,000
					$ 300,000
			Subtotal - Capital Costs:		$ 5,415,075
Capital Contingency	15%	of Capital Cost			$ 812,261
Legal Fees, Licenses &	0.5%				$ 31,137
Engineering & Administrative[1]	8%				$ 498,187
Contractor Fee[2]	10%	of Capital Cost			$ 675,666
			Total Capital Cost:		$ 7,432,326

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	GW#2A — CMZ-3, Groundwater #2A
Location:	McCormick, SC	Title:	Barrier Wall/Grout Curtain

O&M Costs

Item	Qty.		Unit		Unit Cost	Note	Cost ($)
	O&M Period		7.00%	Discount Rate			
			0.00%	Constant Escalation Factor			
7.0 Cap Maintenance and Monitoring	30						**Annual Cost**
Inspect cap, restore vegetation, ever 2nd year. Gauge ~8 monitoring wells							
Labor	30	yr	0.5	total	$ 8,251		$ 4,125
Travel	30	yr	0.5	total	$ 538		$ 269
							$ 4,394
Frequency of Periodic Annual Cost:	1	yrs					
					Net Present Worth (NPW) Subtotal:		$ **54,527**
O&M Contingency			15%	of NPW Cost			$ 8,179
Engineering & Administrative[1]			8%				$ 5,017
Contractor Fee[2]			10%				$ 6,772
					Subtotal - O&M Costs:		$ **74,495**

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

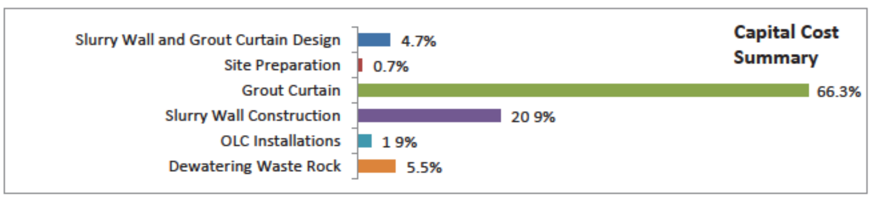
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where: P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 7,506,800



Feasibility Study Cost Estimate				Total NPW Cost:	$3,521,100
		Alternative #:	GW#2B	CMZ-3, Groundwater #2B	
Project:	Barite Hill	Title:	Hydraulic Barrier		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2017
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0

Task Description:	Installation of 8 groundwater extraction wells with pumps upgradient of capped waste rock to create a hydraulic barrier to GW flow through Waste Rock area and into Pit Lake.
Cost Basis:	Detailed estimate

Capital Costs

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
1.0	**Remedial Design/Bench Scale/Pilot Tests**					
	Remedial Design, RD support taks (plans, field investigation, coordination with agencies, permits), travel, treatability and/or pilot tests, site surveys, design vendor support.					
	Remedial Design Professional Labor	1	ls	$ 57,896		$ 57,896
	Remedial Design Travel	1	ls	$ 1,740		$ 1,740
	Materials/Equipment/Subcontractors	1	ls	$ 500		$ 500
	Pilot Scale Testing	1	ls	$ 50,000		$ 50,000
				Design/Bench/Pilot Scale Subtotal:		**$ 110,136**
2.0	**Mobilization/Demobilization of Equipment and Personnel**					
	Mobilization/Demobilization of equipment and personnel (2/2 days).					
	Labor	1	ls	$ 18,296		$ 18,296
	Travel	1	ls	$ 3,427		$ 3,427
	Materials/Equipment/ Subcontractors	1	ls	$ 2,990		$ 2,990
				Mobilization Subtotal:		**$ 24,713**
3.0	**Site Preparation**					
	Utility protection, grubbing, clearing, pre drilling meeting, materials (3 days).					
	Labor	1	ls	$ 2,709		$ 2,709
	Travel	1	ls	$ 593		$ 593
	Materials/Equipment/ Subcontractors	1	ls	$ 7,067		$ 7,067
				Site Preparation Subtotal:		**$ 10,369**
4.0	**Install Extraction Wells**					
	Drilling of (8) 6-inch barrier extraction wells. Drilling to 160 ft bls. Wells screened from ~50 to ~160 ft bls.					
	Labor	1	ls	$ 91,247		$ 91,247
	Travel	1	ls	$ 28,949		$ 28,949
	Drilling Subcontractor Per/Foot Rate	2560	feet	$ 132		$ 337,920
	Drilling Subcontractor - Other	1	ls	$ 24,920		$ 24,920
				Install Injection Well Subtotal:		**$ 483,035**

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	GW#2B — CMZ-3, Groundwater #2B
Location:	McCormick, SC	Title:	Hydraulic Barrier

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
5.0	**Construct and Startup storage and neutralizatin system**					
	Construct and operate a groundwater storage and neutralizaton system. Installation of infiltration pond.					
	Labor	1	ls	$ 26,847		$ 26,847
	Travel	1	ls	$ 7,671		$ 7,671
	Pumps Piping,Controls, Gravity Tanks	1	ls	$ 50,000		$ 50,000
	Storage/Neutralization System	1	ls	$ 500,000		$ 500,000
	Infiltration Pond	2	ls	$ 100,000		$ 200,000
			EISB Delivery System Subtotal:			**$ 784,518**

Notes:

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		Subtotal - Capital Costs:	**$ 1,453,734**
Capital Contingency	15%	of Capital Cost	$ 218,060
Legal Fees, Licenses & Permits[1]	0.5%		$ 8,359
Engineering & Administrative[1]	8%		$ 133,744
Contractor Fee[2]	10%	of Capital Cost	$ 181,390
		Total Capital Cost:	**$ 1,995,286**

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	GW#2B CMZ-3, Groundwater #2B
Location:	McCormick, SC	Title:	Hydraulic Barrier

	Item	O&M Period	Qty.	Unit	Unit Cost	Note	Cost ($)
	O&M Costs						
		O&M Period	7.00% Discount Rate				
			0.00% Constant Escalation Factor				
6.0	**Performance Sampling, O&M Costs**	30					**Annual Cost**
	Site Visits 2 times per month	30	1			1	$ 60,002
	Labor	30	12	ls	$ 1,308		$ 15,695
	Travel	30	12	ls	$ 116		$ 1,393
	Materials/Equipment/Subcontractors	30	12	ls	$ 576		$ 6,912
	Analytical	30	12	ls	$ 500		$ 6,000
					Sampling Subtotal:		$ 30,001
					Net Present Worth (NPW) Subtotal:		$ 1,116,844
	O&M Contingency		15% of NPW Cost				$ 167,527
	Engineering & Administrative[1]		8%				$ 102,750
	Contractor Fee[2]		10%				$ 138,712

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

Subtotal - O&M Costs: $ 1,525,832

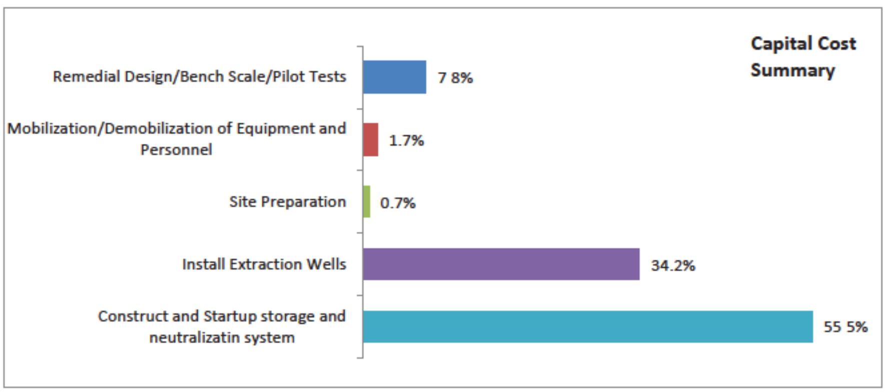
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where:
P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 3,521,100



<u>General Assumptions</u>

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

Feasibility Study Cost Estimate				Total NPW Cost:	$6,721,000
		Alternative #:	GW#3	CMZ-3, Groundwater #3	
Project:	Barite Hill	Title:	Groundwater In-Situ Neutralization		
Location:	McCormick, SC	Project Number:	049038	Base Year:	2107
Project Phase:	OU1 FS Rev 0	Date:	6/14/2018	Revision:	0
Task Description:	Installation of 22 injection wells within the capped waste rock. Injection system designed to neutralize low pH groundwater within the waste rock.				
Cost Basis:	Detailed estimate				

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
	Capital Costs					
1.0	**Remedial Design/Bench Scale/Pilot Tests**					
	Remedial Design, RD support taks (plans, field investigation, coordination with agencies, permits), travel, treatability and/or pilot tests, site surveys, design vendor support.					
	Remedial Design Professional Labor	1	ls	$ 28,332		$ 28,332
	Remedial Design Travel	1	ls	$ 870		$ 870
	Materials/Equipment/Subcontractors	1	ls	$ 25,500		$ 25,500
	Pilot Scale Testing	1	ls	$ 100,000		$ 100,000
				Design/Bench/Pilot Scale Subtotal:		**$ 154,702**
2.0	**Mobilization/Demobilization of Equipment and Personnel**					
	Mobilization/Demobilization of equipment and personnel (2/2 days).					
	Labor	1	ls	$ 18,296		$ 18,296
	Travel	1	ls	$ 3,427		$ 3,427
	Materials/Equipment/ Subcontractors	1	ls	$ 4,230		$ 4,230
				Mobilization Subtotal:		**$ 25,953**
3.0	**Site Preparation**					
	Utility protection, grubbing, clearing, pre excavation meeting, materials (3 days).					
	Labor	1	ls	$ 2,709		$ 2,709
	Travel	1	ls	$ 593		$ 593
	Materials/Equipment/ Subcontractors	1	ls	$ 14,303		$ 14,303
				Site Preparation Subtotal:		**$ 17,605**
4.0	**Install Injection Wells**					
	Install 22, 2-inch injection wells in the waste rock area. Wells will have an average depth of 100 ft bls.					
	Drilling Subcontractor Per/Foot Rate	2200	feet	$ 135		$ 297,000
	Drilling Subcontractor - Other	1	ls	$ 44,110		$ 44,110
	Well Materials	1	ls	$ 8,699		$ 8,699
	Materials/Equipment/ Other Subs/Consumables	1	ls	$ 20,675		$ 20,675
				Install Injection Well Subtotal:		**$ 370,484**

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	GW#3 CMZ-3, Groundwater #3
Location:	McCormick, SC	Title:	Groundwater In-Situ Neutralization

	Item	Qty.	Unit	Unit Cost	Note	Cost ($)
5.0	**Construct/Install Delivery System**					
	Construction and installment of delivery system					
	Labor	1	ls	$ 113,687		$ 113,687
	Travel	1	ls	$ 25,622		$ 25,622
	Site Preparation	1	ls	$ 32,540		$ 32,540
	Mixing Tanks	1	ls	$ 179,000		$ 179,000
	Injection Main Header	1	ls	$ 38,808		$ 38,808
	Injection Manifold	1	ls	$ 64,592		$ 64,592
	Injection Wellhead Assembly	1	ls	$ 9,008		$ 9,008
	Construction of Delivery System Subtotal:					**$ 500,758**

Notes:

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Subtotal - Capital Costs:			**$ 1,069,501**
Capital Contingency	15%	of Capital Cost	$ 160,425
Legal Fees, Licenses & Permits[1]	0.5%		$ 6,150
Engineering & Administrative[1]	8%		$ 98,394
Contractor Fee[2]	10%	of Capital Cost	$ 133,447
Total Capital Cost:			**$ 1,467,917**

[1] Applied to capital subtotal and contingency

[2] Applied to capital subtotal, contingency, fees, and E&A

Feasibility Study Cost Estimate

Project:	Barite Hill	Alternative #:	GW#3 CMZ-3, Groundwater #3
Location:	McCormick, SC	Title:	Groundwater In-Situ Neutralization

Item	O&M Period	Qty.	Unit	Unit Cost	Note	Cost ($)
O&M Costs						
		7.00%	Discount Rate			
		0.00%	Constant Escalation Factor			
7.0 System Operation , O&M Costs	30					**Annual Cost**
Site Visits For Reinjection, collection of groudwater samples						
Labor	30	1	ls	$ 2,125		$ 2,125
Travel	30	1	ls	$ 644		$ 644
System Maintenance/Operation	30	1	ls	$ 100,000		$ 100,000
Amendments/Analytical	30	1	ls	$ 207,090		$ 207,090
				Sampling Subtotal:		$ 309,859
				Net Present Worth (NPW) Subtotal:		$ 3,845,058
O&M Contingency		15%	of NPW Cost			$ 576,759
Engineering & Administrative[1]		8%				$ 353,745
Contractor Fee[2]		10%				$ 477,556
				Subtotal - O&M Costs:		$ 5,253,119

[1] Applied to O&M subtotal and contingency

[2] Applied to O&M subtotal, contingency, and E&A

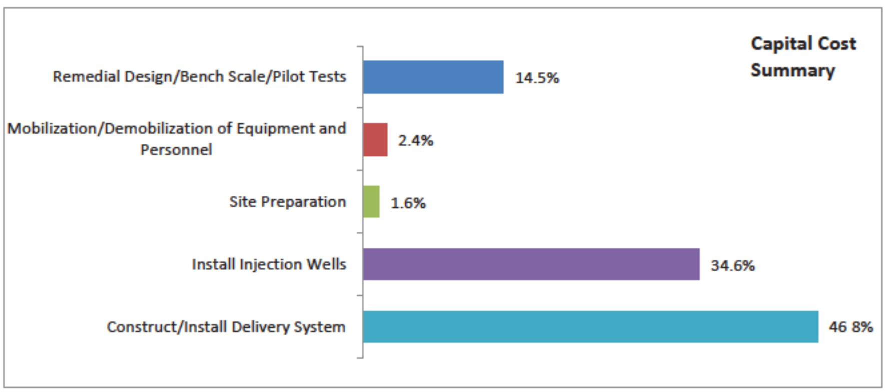
Net Present Worth Formula

$$P = A_o \times \left(\frac{1+e}{d-e}\right) \times \left[1 - \left(\frac{1+e}{1+d}\right)^n\right]$$

where:
P = Present Value ($)
Ao = Annual Amount ($)
d = discount rate
e = escalation factor
n = time period (yrs)

Note: Net Present Worth derived from summation of Modified Uniform Present Value (UPV*).

Total NPW Cost Estimate: $ 6,721,000



General Assumptions

1. Professional rates are averaged to reflect typical labor rates for personnel required for project.
2. Cost basis derived from professional judgment and experience unless specified directly.
3. Costs are derived to be (-30% to +50%)

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